ANALYTIC HIERARCHY PROCESS FOR DECISION MAKING IN KINESIOLOGY: AN APPLICATION IN SELECTING ATHLECTIC SHOES FOR WALKING

BY

YOUNGSIK PARK

DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Kinesiology
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2011

Urbana, Illinois

Doctoral Committee:

Professor Weimo Zhu, Chair
Associate Professor Synthia Sydnor
Assistant Professor Juhee Kim
Professor Tony Mendes, University of North Texas

ABSTRACT

People often have difficulties in making decisions when a judgment of multiple criteria simultaneously is a part of the decision-making. Fortunately, the method like Analytic Hierarchy Process (AHP) has been developed to assist the multi-criteria decision making. Yet, AHP has not been introduced to the field Kinesiology. The purpose of this study, using a study of selecting quality athletic shoes for walking, was to introduce AHP to Kinesiology. People often have a difficulty in selecting quality walking shoes because of many alternatives and multiple criteria that can cause conflicts in evaluating alternatives. Forty participants (20 males and 20 female; Age: *M* = 28.72 and *SD* = 10.87) were recruited from a Midwestern shoe store for the study and they were classified two age groups (19-24 yrs. and over 25 yrs.). A two-stage decision strategy was employed for the study. In the first stage, the number of alternatives was lowered to a manageable level and the participants were asked to make a selection decision from a consideration set of shoes formed for the study. In the second stage, the participants were asked to make a selection decision with the assistance of AHP. The AHP method was compared to self-explication method—natural way of making choices without interventions. The decision effectiveness in the consideration set, the AHP method, as well as the relationship between the consideration set and the AHP method, were investigated. It was found that, when forming a consideration set and putting on shoes and walking around the store for a while, *technical feature* and *brand* was significant shoe attributes to affect the participants' decision on shoe selection. In making further preferred choices from the consideration set after a shoe test, however, *quality*, the shoe

attribute added after the shoe-test, and *technical feature* played significant roles in affecting the decision. No significant difference in the quality of a consideration set, which was evaluated by the number of quality shoes within a consideration set, was detected between two age and gender groups; but there a significant interaction effect between age and gender. AHP was a useful tool to help consumers to make a good decision—selecting quality athletic shoes for walking according to perceived preference—according three evaluation outcomes: the consistency of preference, the effectiveness of AHP, and the satisfaction to AHP. The relationship of the number of quality shoes within a consideration set was significant with the consistency, but with the effectiveness and satisfaction of AHP.

To my wife, Hyejin, and my daughter, Sojung

ACKNOWLEDGEMENTS

Thank you, God, for your helping me finish the dissertation. I would like to say "thank you" to all of the people I knew while I studied in University of Illinois at Urbana-Champaign. Special appreciations go to three groups of people: the committee members of this dissertation, the members of Kinesmetrics Lab, and my family members. The first special thanks go to the committee members: Dr. Zhu, Dr. Sydnor, Dr. Kim, and Dr. Mendes. Without the generosity, encouragement, and support of the committee members for more than three years, I could not finish my dissertation. I was very lucky to have these wonderful committee members. The second special thanks go to the members of Kinesmetrics Lab, Dr. Zhu (my advisor and the committee chair), Heidi (the lab coordinator and the editor of my dissertation), Yong, Miyoung, Marco, Vince, Dr. Youm, and Sanghee. Additional appreciations go to Heidi, Vince, Dr. Youm, and Sanghee who helped me collect the data in a tough situation. The last special thanks should go to my wife, Hyejin, and my daughter, Sojung. I appreciate the patience and support of my wife and daughter while I studied in the United States for long time. We, our family members, passed through all of difficult times together and arrived to the Ph.D degree. In addition, I would like to give thanks to my mother and sister. It was really a tough time to study as a graduate student at UIUC. I wanted to give up several times. However, with the help of the people I mentioned above, I was able to arrive to the finish line. Thank you, all.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Decision Making

Human beings make many decisions every day. Some decisions are trivial, such as what to eat for lunch, how to get to work, and which TV program to watch. Other decisions are more important and happen only occasionally, such as which college to attend, where to live, and what to do for a living. People cannot survive without making decisions. Making good decisions is a crucial technique for survival. The decisions people make every day affect their lives in the present and their life in the future.

Many studies have been conducted on decision making to understand how people make decisions and to provide techniques for making good decisions.

> Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that there are alternative choices to be considered, and in such a case we want not only to identify as many of these alternatives as possible but to choose the one that best fits with our goals, objectives, desires, values, and so on (Harris, 2008, What is Decision Making? section, para. 1).

Good decision making means that we are informed and that we have relevant and appropriate information on which to base our choices (Sauter, 1997). The decision making process is directly related to information processing: how to collect information and analyze the gathered information (Sauter, 1997).

Understanding how people make decisions and what are effective techniques in decision making can help produce better decisions. In making decisions, decision strategies are used to compare alternatives with one another and to select the best option based on comparison results (Payne, Bettman, & Johnson, 1993). Human beings are adaptive decision makers in the sense that they can apply different decision strategies and switch among them depending on the characteristics of the decision task, such as the number of alternatives and attributes (Beach & Mitchell, 1978; Payne, 1982; Payne, Bettman, & Johnson, 1988, 1993; Takemura, 1985). The more alternatives and criteria decision makers have, the more complicated and harder decision making will be (Schwartz, 2000).

Decision makers are not perfectly rational, but they are "rationally bounded" (Newell & Simon, 1972). In actual decision making, most people are much poorer at decision making than they think they are. Though human behavior is intended to be rational, decisions are rational only in a restrictive sense because it depends on a decision maker's capacity to collect and analyze information (Simon, 1987). From a practical standpoint, it is impossible for a decision maker to evaluate all pieces of information available.

Multi-Criteria Decision Making

Most decision making involves complicated procedures in which decision makers rank the alternatives of a choice according to multiple criteria (Saaty, 2008). Decision makers have trouble in considering multiple criteria together when they make a choice among several or many alternatives. There have been many studies that have

provided solutions for complicated decision making including multiple criteria. “Multi-Criteria Decision Making (MCDM) is the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process" (International Society on Multiple Criteria Decision Making, n.d., para. 1). MCDM consists of three components: decision goal, decision criteria and alternatives. Typical examples of MCDM are provided in Table 1.1. In making a choice, priorities for alternatives are generated by evaluating criteria or sub-criteria. Alternatives are ranked according to accumulated priorities across criteria. The rank order can be used for choosing the best option and for other purposes.

Applications of Analytic Hierarchy Process (AHP)

Many quantitative methods have been developed to facilitate making rational decisions involving multiple criteria. One such method is the Analytic Hierarchy Process (AHP) developed by Saaty (1980). AHP is one of the most widely used MCDM tools. Since its development, the AHP has been successfully applied to solve a wide range of multi-criteria decision-making problems. The themes of applications were selection, evaluation, benefit-cost analysis, allocations, planning and development, priority and ranking, and decision-making, and AHP has been applied to many areas, such as politics, engineering, education, industry, government (Vaidya & Kumar, 2006). This useful technique, however, is basically unknown to the field of Kinesiology.

In this study, AHP is introduced to Kinesiology by using a real-life problem in practice: How to select athletic shoes with good quality for walking. Specifically, AHP was used as a supporting tool for selecting walking shoes.

Table 1.1

Examples of MCDM

Goal	Criteria	Alternatives
Selecting a school	• Distance • Neighborhood • Standard test score • Teacher's reputation	Schools under consideration
Finding an apartment	• Rent • Deposit • Parking spaces • Facilities • Distance from work • Neighbors' friendliness	Apartments under consideration
Determining thesis topic	• Time to complete • Research cost • Level of interest	Thesis topics
Buying a car	• Price • Design • Mileage • Warranty • Used car price	Cars available for purchase

Walking Shoes

Athletic shoe is a generic name for footwear designed for sporting and physical activities. Under the term athletic shoe, many subcategories of shoes are included, such as running, cross-training, walking, basketball, hiking, tennis, etc.; in general, if there is a sport there is a specific athletic shoe for it. Walking shoes, one subcategory of athletic shoes, typically represent the athletic shoe specifically designed for walking. In this study, these walking shoes are called "specialty walking shoes." "Walking shoes" have a different definition: they represent the athletic shoes used for walking regardless of category (e.g., running shoe, basketball shoe, and tennis shoe) of athletic shoe.

There are two major functions of footwear: protection and fashion. As footwear, walking shoes have basically the same two functions as most shoes do. In terms of the protection function, our feet require the protection of shoes to assist in comfort, to reduce injury and to improve performance. An improperly fitting shoe is one of the major causes of walking injuries. The discomfort resulting from walking can be prevented or alleviated by wearing proper shoes (Coughlin, 1996; Frey, Thomson, Smith, Sanders, & Horstman, 1993). In terms of the fashion function, walking shoes share the function with athletic shoes. In the history of athletic shoes, athletic shoes were adopted by the young as tie-symbols, defined by Rubinstein (2001) as expressions of support or association with a particular idea, cause, predicament, or person.

Technical advances, such as improvement in function or style along with technology, brought about the changes in both of the two functions of shoes. With technical advances in athletic shoes, such as improvement of comfort in cushioning or weight, athletic shoes set the standard for all shoes and became part of a "cool" style (Vanderbilt, 1998).

Purchase of Walking Shoes

According to major sales reports on athletic shoes, most people do not care much about which category of athletic shoes they buy for walking: they buy various types of athletic shoes instead of specialty walking shoes for walking. In the athletic shoe market, the fashion function plays a major role in making market trends (The NPD Group Inc., 2007). Though consumers select various categories of athletic shoes for walking, experts still recommend to select proper shoes which provide good protection function. Comfort and fit are two key factors that need to be considered in choosing quality shoes (Pribut & Richie, 2004). In addition to comfort and fit for quality, consumers can consider also other attributes such as fashion, technical features, price, and brand name.

Problems and Challenges in Selecting Walking Shoes with Good Quality

Among technical features (e.g., Gel Cushioning System [Asics], Pro-moderator [Adidas], duoCell [Puma], Smart Comfort System [Timberland], etc.) that athletic shoe companies have developed to improve quality of shoes, most of those features are tricks that make athletic shoes more expensive (Pribut & Richie, 2004). A high price is related more to technical features and fashion than high quality (Clinghan, Arnold,

Drew, Cochrane, & Abboud, 2008; Pribut & Richie, 2004). When consumers buy athletic shoes, which have recent technical and fashion features developed by major athletic shoe companies, they are perceived to buy shoes of good quality. Consumers actually purchase fancy and expensive shoes regardless of shoe quality. The possibility of discrepancy is expected between consumers' actual choices and perceived choices.

This discrepancy between actual and perceived choices is closely related to the complexity of selecting quality walking shoes: too many alternatives and multiple criteria (or attributes such as quality, brand, fashion and price). As the number of alternatives and criteria gets larger, decision making becomes harder and more complicated (Mintz, Geva, Redd, & Carnes, 1997; Olshavsky, 1979; Schwartz, 2000). There are too many athletic shoes and their designs change too often for consumers to get enough information on athletic shoes available in the market place. Also, they need to consider multiple criteria (or attributes such as quality, brand, fashion and price) in evaluating alternative shoes to make a final choice. Consumers should simplify the decision making procedure by examining only relevant criteria (Johns, 1999).

The solution for the problems and challenges in selecting walking shoes can be sought in decision making studies. There have already been many studies on "decision making," which provided solutions for problems and difficulties happening in various kinds of decision making situations. Selecting walking shoes is a typical consumer decision making situation, in which consumers make a choice among many alternatives by evaluating alternatives with respect to multiple criteria.

Two-Stage Choice Strategy for Consumer Decision Making

Decision strategy is about how to compare alternatives with one another and select the best option based on comparison results (Payne et al., 1993). A two-stage strategy is likely to be used in consumer decision makings, such as selecting athletic shoes, when the number of alternatives is large (Bettman, 1977). In the first stage, decision makers try to make a smaller alternative set by eliminating alternatives below threshold value(s) in one or more particular attributes (Ben-Akiva & Boccara, 1995; Wright & Barbour, 1977). In the second stage, after the reduced set of alternatives reaches a more manageable level, consumers apply a detailed analysis in evaluating the resulting alternatives (Wright & Barbour, 1977). A small and manageable set of alternatives selected as a result of the first stage is called a consideration set (Brisoux & Laroche, 1981; Laroche, Kim, & Matsui, 2003; Narayana & Markin, 1975).

Theoretical Backgrounds of AHP

The decision contexts of the second stage are such that a decision maker makes a final choice by evaluating several alternatives across all important criteria, which is a multi-criteria decision making. Alternatives are ranked according to accumulated priorities (preference weights) across the criteria (Stewart, 1988, 1991). The rank order can be used for choosing the best option and other purposes. AHP has been one of the most widely used MCDM tools. AHP has been used in almost all applications (e.g., planning, selecting a best alternative, resource allocations, resolving conflict, optimization, etc.) related to decision-making (Vaidya & Kumar, 2006). The usefulness of AHP is dependent on how well it can resolve complex problems and

handle different types of data. AHP is based on customization (e.g., Calantone, Di Benedetto, & Schmidt, 1999; Dyer, Forman, & Mustafa, 1992; Vargas & Saaty, 1981), especially with the ability to make sense in comparing alternatives with different types of data together, for which there are no standard scales for measurement. In selecting walking shoes, the types of data for the attributes, such as comfort, fit, technical features, fashion, brand name, and price, are very different from each other. It is very difficult to merge those different data into summed preference values. AHP can be a good tool for taking care of this problem.

AHP has three major functions: structuring complexity, measuring on a ratio scale, and synthesis (Forman & Gass, 2001). Concerning complexity, Saaty (2001) found that human beings solved complicated problems by putting them into hierarchy structures that classify complex systems into several hierarchical levels and then simplify elements of each level into clusters with respect to the element—called parent—of adjacent higher level. Related to the second function, measuring on a ratio scale, Saaty (2001) discussed that "[AHP] is used to get ratio scales from both discrete and continuous paired comparisons in multilevel hierarchy structures" (p. 3). Due to the second function, measuring on ratio scales, different types of data can be dealt with together in AHP. About the third function, synthesis, Saaty (1994a) explained that people need a way to synthesize over many dimensions because complex and crucial decision situations often involve too many dimensions for humans to synthesize intuitively. Synthesis is a required function for people to evaluate alternatives and calculate priorities according to their preferences.

As principles for achieving the three major functions of AHP, Saaty (1994a) discussed the three basic principles of AHP: decomposition, comparative judgments, and hierarchical composition or synthesis of priorities. The decomposition principle is applied to structure a complex problem into a hierarchy of clusters; the principle of comparative judgments is applied to construct pairwise comparisons of all combinations of elements in a cluster; finally the principle of hierarchical composition or synthesis is applied to multiply the local priorities of the elements in a cluster by the global priority of the parent element.

AHP as Decision Support System

A decision support system (DSS) is any tool used to improve the process of decision making in complex systems, particularly where information is uncertain or incomplete (Silverman, Bachann, & Al-Akharas, 2001). There have been a large number of DSS applications that incorporate AHP as a decision making tool (Power & Sharda, 2007). In applying AHP to selecting walking shoes, it can work as a DSS by helping consumers improve the process of making a choice of walking shoes.

Evaluation of the Two-Stage Strategy

For evaluating the first stage, the performance of purchasing a product can be measured by evaluating consideration set quality (Haubl & Trifts, 2000). Measurement of the consideration set quality is conducted by counting the number of good quality shoes, which have higher criteria values in the consideration set. Concerning the evaluation of the second stage, performance is the most important outcome in decision making in term of evaluating DSS (Lilien, Rangaswamy, Bruggen, & Starke,

2004; Sharda, Barr, & MCDonnell, 1988). DSS should improve performance of decision making in terms of consistency and effectiveness. Satisfaction is an important outcome in the study of DSS (Lilien et al., 2004). Satisfaction of DSS users is a major criterion for evaluating the success of DSS.

Hypothesis of the Study

Three sets of hypotheses were tested by stage: the first stage for selecting a consideration set, the second stage for making the final choice using the AHP method , and the last stage for checking the interaction between the two stages.

First stage. For this stage, the hypotheses consist of two sections to examine: the quality, in the first section, and the choice, in the second section, of the shoes selected for forming a consideration set.

In the first section, the hypothesis tests were conducted to investigate the effect of gender and age on the number of quality shoes within a consideration set. The second section consisted of three subsections. In the first subsection, the hypothesis tests were conducted to examine how shoe selections for forming a consideration set were predicted by four shoe attributes, such as *technical features*, *fashion*, *brand*, and *price*, which can be detected without the shoe-test—putting on shoes and walking around the store for a while. The second subsection was to examine further shoe selections within a consideration set to determine how people select shoes after the shoe-test. The five alternatives selected for forming a consideration set were divided into three groups: selected as a consideration set but not selected as three better choices, selected as three better choices but not selected as best choice,

and selected as best choice. The hypothesis tests were conducted to investigate how the three groups were selected among the five alternatives of a consideration set in terms of five shoe attributes–*quality* as a shoe attribute was added to the four attributes because shoe quality could be evaluated after the shoe-test.

Second stage. The hypotheses of the second stage consisted of three parts: the consistency of preference, the effectiveness of the AHP method, and the satisfaction to the AHP method. The AHP method was compared to the self-explication method, which is a way of selecting athletic shoes as naturally as consumers buy athletic shoes in retail stores without any restriction or intervention.

For the first part, the consistency of preference was defined by the similarity in shoe selections between AHP and self-explication method. The hypothesis tests were conducted to evaluate the associations of the consistency with gender and with age. For the second part, the effectiveness of the AHP method was assessed by the acceptance of the recommended choice of the AHP method. The hypothesis tests were conducted to investigate the association of the effectiveness with gender and age. For the third part, the satisfaction of AHP method was defined in two ways: first, the satisfaction of the selection procedure of the AHP method and second, the satisfaction of the final choice. The hypothesis tests were executed to investigate the associations of the satisfaction with gender and with age. The relationships of satisfaction with the consistency and with the effectiveness were examined in the hypothesis tests.

Third stage. The good decision making of the second stage should be closely related to the quality of the consideration set. Athletic shoes included in a

consideration set need to be of good quality to select a good-quality shoe as a final choice. In this stage, the shoe quality of a consideration set is defined as the number of quality shoes. The associations of the shoe quality of the consideration set with the evaluation factors of the AHP method were evaluated in the hypothesis tests.

Purposes of the Study: Two Specific Aims Related to Each Stage

The purpose of this study was to introduce the AHP method to Kinesiology using a sample study—selecting quality athletic shoes for walking. In the sample study, the goal was to evaluate the efficiency of a two-stage decision support system (DSS) by applying it to selecting walking shoes. Specifically, it is to determine if consumers can make quality decisions, in which they can make choices according to their preferences with the help of the AHP method.

Importance of the Study

Decision making is everywhere, including in Kinesiology. Yet, effective procedures that may help make a quick and effective decision have basically not been introduced to Kinesiology. AHP, a decision-making aid procedure, has been applied to various problems across many different fields. AHP should be a proper tool for solving complicated decision making problems with many decision criteria and alternatives in Kinesiology. People are supposed to buy quality shoes that provide comfort and fit while walking. There has been so far no practical method for selecting walking shoes with good quality. This study proposed an evaluation tool that consumers can use to select walking shoes with good quality, which is critical to foot health.

CHAPTER 2

LITERATURE REVIEW

Walking is the most popular physical activity (PA) for men and women across all age groups (Simpson et al., 2003). As a moderate PA, walking is a typically recommended activity to most people for its health benefits. People need to wear quality shoes for walking to get health benefit from walking without injuries. *Comfort* and *fit* are two key factors that need to be considered in choosing quality shoes (Pribut & Richie, 2004). In addition to comfort and fit for quality, consumers are supposed to consider also other attributes such as *fashion*, *technical features*, *price*, and *brand name* according to their preferences.

People often have a difficulty in selecting proper walking shoes because of two reasons. First, there are too many shoes for walking available in the market place to get enough information on those shoes. Second, they need to consider multiple criteria (or attributes such as comfort, fashion, brand, price, etc.) to evaluate alternative shoes to make a final choice. The solution for challenges in selecting walking shoes can be sought in decision making studies. A two-stage strategy is likely to be used when the number of alternatives is large (Bettman, 1977). This strategy can be applied to consumer decision making (e.g., selecting walking shoes). In the first stage, decision makers try to make a smaller alternative set by eliminating alternatives below threshold value(s) in one or more particular attributes (Ben-Akiva & Boccara, 1995; Wright & Barbour, 1977). In the second stage, after the reduced set of alternatives reaches a more manageable level, decision makes apply a detailed analysis

in evaluating the resulting alternatives (Wright & Barbour, 1977). AHP has been one of the most widely used method for a detailed analysis, which support a complicated decision making in which multiple decision criteria are included.

AHP has been applied to many research areas such as personal, social, manufacturing sector, political, engineering, education, industry, government, and management. This method has not yet been applied to Kinesiology. The two-stage choice method will be applied to “selecting walking shoes” to introduce the AHP method to Kinesiology.

PA, Walking, and Health

PA is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure" (Caspersen, Powell, & Christenson, 1985). Walking, a specific mode of PA, is defined as "an act or instance of going on foot especially for exercise or pleasure" (Merriam-Webster's Collegiate Dictionary, 1993). As a moderate PA, walking is a typically recommended activity to most people for its health benefits. In 1995, the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) published a PA recommendation based upon the scientific consensus that substantial health benefits can accrue from moderate-intensity PA (3-6 METs) of at least 30 min per day. One MET (metabolic equivalent) is defined as a unit of RMR (Resting Metabolic Rate) and the energy cost of a PA can be calculated as multiplies of the RMR, body weight, and time spent (Ainsworth et al., 1993). The main example of moderate-intensity activity recommendation is brisk walking at 3 to 4 mph. According to the 1996 report of the Surgeon General on

physical activity and health, a typical amount of moderate activity is walking 2 miles in 30 minutes. In the 2008 Physical Activity Guideline for American, “For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Aerobic activity should be performed in episodes of at least 10 minutes, and preferably, it should be spread throughout the week” (p. vii). On an absolute scale, moderate-intensity physical activity is done at 3.0 to 5.9 METs. Walking at 3.0 mile per hour requires 3.3 METs of energy expenditure and is considered moderate-intensity activity.

Evidence of the health benefits of walking comes largely from epidemiologic studies. According to the 2008 Physical Activity Guideline for American, physical inactivity plays a role in many health risks, including:

> Premature (early) death; Diseases such as coronary heart disease, stroke, some cancers, type 2 diabetes, osteoporosis, and depression; Risk factors for disease, such as high blood pressure and high blood cholesterol; Physical fitness, such as aerobic capacity, and muscle strength and endurance; Functional capacity (the ability to engage in activities needed for daily living); Mental health, such as depression and cognitive function; and Injuries or sudden heart attacks (p. 7).

The 2002 report on “Physical Activity Fundamental to Preventing Disease,” by the U.S. Department of Health and Human Services showed that regular PA could prevent or improve chronic diseases and conditions like heart disease, stroke, colon cancer,

diabetes, obesity, arthritis and osteoporosis. In several published studies on walking and all-cause mortality among people with diabetes (e.g., Batty, Shipley, Marmot, & Davey-Smith, 2002; Gregg, Gerzoff, Caspersen, Williamson, & Narayan, 2003; Tanesescu, Leitzman, Rimm, & Hu, 2003), 2.0 to 5.3 (or more) hours/a week of walking might reduce mortality by 40% to 54%, and walking at a moderate or even faster pace might reduce the mortality by 40% to 60%. In large cohort studies, walking showed significant effect on lowering the risk of coronary heart disease. In the Harvard Alumni Health Study, men who walked 5 to less than 10 km/a week (approximately 3 to <6 miles/a week) had a 13% lower risk of coronary heart disease, which was statistically significant compared to men walking less (Sesso, Paffenbarger, & Lee, 2000). In the Women's Health Study, women 45 years of age and older showed similar results to men in Harvard Alumni Study. Their walking duration and speed were inversely related to the low risk of coronary heart (Lee, Rexrode, Cook, Manson, & Buring, 2001). According to some studies on walking and cause specific mortality (e.g., Hakim et al., 1998; Stamper, Hu, Manson, Rimm, & Willett, 2000), walking showed some positive results in decreasing the mortality rate from cardiovascular disease and cancer.

Walking is now a popular topic in public health studies. Lee et al. (2001) explained seven specific reasons why walking is a popular topic in public health study. First, people like to walk. In epidemiological studies, walking was reported as the most popular type of leisure time PA in the United States (Siegel, Brackbill, & Heath, 1995; Simpson et al., 2003). Walking is also the most commonly reported activity in adults who meet national recommendation—5 or more days per week and 30 or more

minutes on each day (Simpson et al., 2003). Second, almost anybody can walk without many limitations in regards to gender, age, space, time, and so on. This easy accessibility explains several specific reasons: same expected health effect for all population groups “regardless of gender, age, racial group, and socio-economic level” no need for “special equipment, skill, or facilities,” and no space limitation. “In this regard, walking is particularly important for its potential to reduce disparities in health related to lack of PA” (Lee et al., 2001, p. 516). Third, walking is important to elderly people. As people get older, the prevalence of walking gets larger (Siegel et al., 1995; Simpson et al., 2003). Lee et al. (2001) described that “Because the preference for more moderate intensity activities, such as walking, increases with age (Eyler, Brownson, Bacak, & Housemann, 2003, as cited in Lee et al, 2000), walking emerges as a leading therapeutic modality” (p. 516). Fourth, walking can be used as proper PA for representing the problems (relationship or causality) between obesity and physical activity. Whole PA can be represented as walking because walking is a part of many other PA. Lee et al. (2001) explained that “The most obvious role of walking is in producing increases in caloric expenditure” (p. 517). Last three reasons are lower risk of injury, indirect benefits of walking, such as reducing car use and air pollution, and proven evidence as an effective intervention in public health studies (Kahn et al., 2002; Reger et al., 2002, as cited in Lee et al, 2001).

Walking and Walking Shoes

While walking in general is the most popular PA, to which most people can enjoy without worrying much about injuries, there are still possibilities of injuries

coming from walking. One important reason for these injuries is related to improper shoes for walking. It is necessary to wear proper shoes for walking for foot health.

Prevalence of Walking in the U.S.

In the study "Walking Trends Among U.S. Adults," Simpson et al. (2003) described how walking in the U.S. had changed between 1987 and 2000 using data from Behavioral Risk Factor Surveillance System (BRFSS). Walking was the most popular PA for men and women across all age groups. They reported that the prevalence, the total number of cases in the population, of walking among men increased 3.8% from 26.2% in 1987 to 30.1% in 2000. In women, walking increased 6.6% from 40.4% to 46.9% during the same time. Across all age groups and all other subgroups, walking was always more popular with women than men. The prevalence of walking was two to three times higher than those of the next most frequently reported activities. According to another epidemiologic study of walking as a PA in the US conducted in 1999-2000, about 34% of the population were defined as regular walkers who met public health recommendation by walking—five times a week and at least 30 minutes at a time, 45.6% were occasional walkers who walked for PA but did not meet the recommendation, 20.7% were never walkers, which means they did not walk as a means of PA (Eyler et al., 2003).

Participation of Walking in Sports Participation Report in the U.S.

There is another way of figuring out how many people participate in walking. In marketing areas, major sporting goods market reports provide the information on the participation of fitness and sports activities including walking. According to the

Sporting Goods Manufacturers Association's (SGMA) Sports & Fitness Participation Report (see Table 2.1), walking for fitness was the most popular activity among all sports and fitness activities in 2007. There were 108,781,000 (40% of total population) walking participants and 76,837,000 (28% of total population) core (50+ days/year) walking participants in the United States. The total number of population age six and above was 274,796,000.

Table 2.1

Leading Fitness Activities Based on "Core" and "Total" Participation (Age 6 and above; 2007 Participants; U.S. Residents; Source: SGMA)

	"Core"	"Total"	% of "Core"
Rank/Sport	Participants	Participants	Participants
Walking for Fitness	76,837,000	108,781,000	70.6%
Treadmill	29,182,000	50,100,000	58.2%
Stretching	28,318,000	36,260,000	78.1%
Hand Weights	28,186,000	43,734,000	64.4%
Running/Jogging	24,240,000	40,966,000	59.2%

Note 1. "Core" means the level of frequency of 50+days/year. "Total" means at least once a year.

Note 2. This table is from Sporting Goods Manufacturers Association, 2008.

According to another major sport participation reports (see Table 2.2) by National Sporting Goods Association (NSGA), exercise walking was the most popular fitness activity, in which most American people participated in 2004. The number of exercise walking participants was 77,645,000 in 1998 and 84,718,000 in 2004, which was a 9.1% increase.

Table 2.2

Sports Participation in Fitness Activities, 2004 vs. 1998 (Source: NSGA)

Activity	Number of Participants		
	1998	2004	% change
Exercise Walking	77,645,000	84,718,000	9.10%
Exercise with Equipment	46,145,000	52,168,000	13.10%
Workout at Club	26,544,000	31,805,000	19.80%
Aerobic Exercise	25,764,000	29,458,000	14.30%
Running/Jogging	22,525,000	24,665,000	9.55%

Note 1. Number of participants represents individuals participating at least once during the year in each activity.

Note 2. This table was adapted from Lipsey, 2007, p.25.

Walking and Athletic Shoes

Athletic shoe is a generic name for footwear designed for sporting and physical activities. Under the term athletic shoe, many subcategories of shoes are included, such as running, cross-training, walking, basketball, hiking, tennis, etc; in general, if

there is a sport there is a specific athletic shoe for it. Walking shoes, one subcategory of athletic shoes, typically stand for the athletic shoes specifically developed for walking. In this study, these walking shoes are called “specialty walking shoes.” “Walking shoes” have a different definition: they represent the athletic shoes used for walking regardless of category (e.g., running shoe, basketball shoe, and tennis shoe) of athletic shoes.

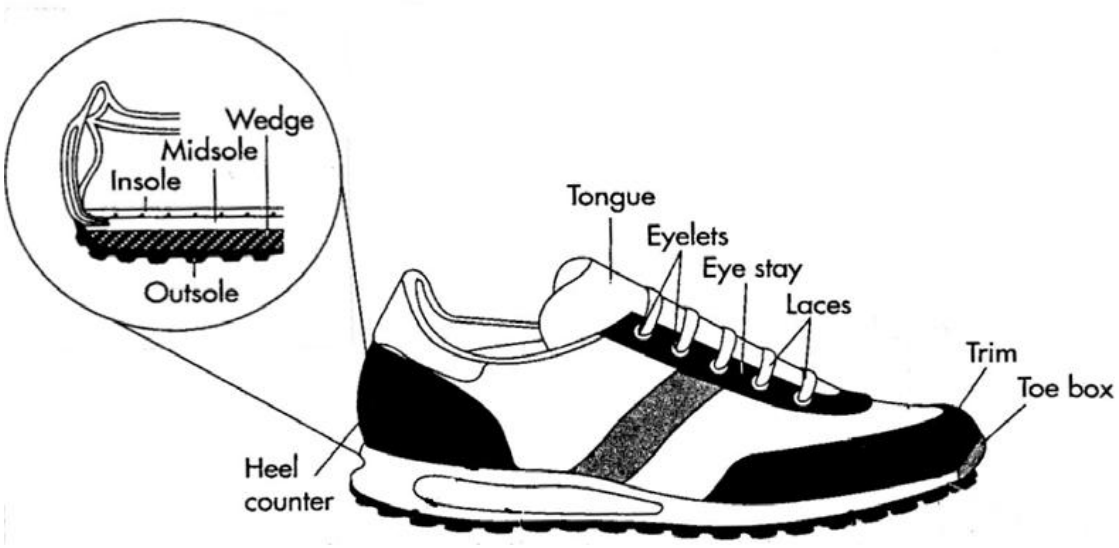
Specialty walking shoes are built to support the foot during walking for exercise, walking long distances, or simply casual walking. Sometimes people more loosely define specialty walking shoes as merely comfortable shoes designed for regular wear. Usually there is a greater distinction between comfortable shoes and specialty walking shoes, and shoes of the athletic type are more suited to increased activities such as exercise walking and longer walking times.

Specialty walking shoes are specifically designed for the mechanism of walking. As a walking gait is much different from a running gait, specialty walking shoes are substantially different from running shoes specifically in the midsole—the cushioning layer underneath the shoe (see Figure 2.1 and Table 2.3). The body is totally airborne for a period of time during running whereas at least one part of the body (usually indicating foot) contacts the ground for the whole gait cycle during walking (Enoka, 2008; Hamilton & Luttgens, 2002). While two and a half to three times one’s body weight needs to be supported when a foot touches the ground during running, much less weight needs to be supported during walking (Cavanagh, 1987; Hamilton & Luttgens, 2002). Therefore, running shoes are designed to support three times the

body weight and specialty walking shoes only about 1.5 times body weight. Because of this difference, specialty walking shoes have thinner midsoles than running shoes. Another difference comes from foot strike. While walkers take a natural foot roll from the heel through to the toes, runners touch the ground first with the midfoot or the whole foot (Hamilton & Luttgens, 2002). Because of this difference in foot strikes, specialty walking shoes have thinner midsoles and more flexible outsoles (the bottom of shoes) both of which allow more natural roll-through motion than running shoes.

Figure 2.1

Parts of an Athletic Shoe



Note. Adapted from "Parts of an Athletic Shoe," by Three Polymer Ambassadors, 2003, *Designer Sneakers: Student Pages*, p.7. by the Akron Global Polymer Academy.

Table 2.3

Parts of an Athletic Shoe

Parts	Description
Heel Counter	This stiffens the back of the shoe for stability. It is molded to encase the heel and surrounds the Achilles tendon.
Insole	It cushions and provides an arch support that should be removable. The foot rests upon the insole of the shoe.
Last	The mold or form around which the shoe is shaped during manufacture.
Midsole	The cushioning material – (usually ethyl vinyl acetate (EVA) or polyurethane) – often surrounded by air cells or gel cells for shock-absorbing quality is the make-up of the midsole. This is found between insole and outsole.
Outsole	This part touches the ground and is made of durable carbon rubber or polyurethane. The carbon rubber has better traction.
Toe box	The area for the toes of the foot.
Ankle Collar	The padded area around the top of the shoe for added fit and comfort.
Heel Tab	The area of the ankle collar that is usually notched and located above the heel. It reduces stress on the Achilles tendon.

Note. Adapted from "Parts of an Athletic Shoe," by Three Polymer Ambassadors, 2003, *Designer Sneakers: Student Pages*, p.7. by the Akron Global Polymer Academy.

Functions of Walking Shoes

There are two major functions for wearing shoes. The fundamental function of shoes is foot protection from the environment (Tyrrell & Carter, 2009). Even primitive people protected their feet with vegetable fibers or animal skins to make the feet more comfortable and prevent damage. The other function, though it is not a major function, of the shoe is fashion. Shoe styles and shapes have changed with fashion through the centuries (Tyrrell & Carter, 2009). As a kind of shoe, walking shoes have basically the same functions as most shoes do. Additionally, specialty walking shoes as a category of athletic shoes are supposed to have more of the protection function than casual or dress shoes do.

Protection Function of Shoes

In physical activities such as running, walking and jumping, our feet require the protection of the shoe to assist comfort, to reduce injury and to improve performance. There have been many assertions that shoes typically improve performance and offer protection from injury (Barrett & Bilisko, 1995). It is thought that improved movement association between foot and shoe has the benefits of movement efficiency and comfort, both of which have been identified as important factors for the reduction of injury (Mundemann, Stefanshyn, & Nigg, 2001). For podiatrists who are involved in the management of musculoskeletal lower limb injury, the shoe can be considered a powerful tool for controlling human motions in regard to their lower limbs (Barnes & Smith, 1994), which provides advantages in the protection function of shoe (Cavanagh,

1980; Maier & Pietrocarlo, 1991) or conversely, may alter lower extremity movement patterns that might result in injury (Nigg & Segesser, 1992).

The shoes that one wears are directly related to the health of the lower limbs. Though people enjoy walking regardless of gender, age and race without worries about injuries (Lee et al., 2001), there is possibility of experiencing aches and pains. In most cases, those aches and pains come from "improper walking technique; improper shoes or socks; walking surfaces that are too hard; or too much walking, too soon" (Boone, 2007, section 1, para. 3). An improper shoe is one of the major reasons for walking injuries. Discomfort resulting from walking, which occurs mostly in the feet, ankles, and legs, can be prevented or alleviated by wearing proper shoes. Walking injuries and their relations to shoes are summarized in Table 2.4.

Studies on shoes and injuries support that improper shoes can cause health problems mentioned in Table 2.4 and those problems can be preventable and relieved by wearing proper shoes. According to the American Academy of Orthopaedic Surgeons (AAOS), "More than 43.1 million Americans—one in every six persons—have trouble with their feet, mostly from improperly fitting shoes. A huge public health risk, foot problems cost the U.S. $3.5 billion a year" (American Academy of Orthopaedic Surgeons, n.d., chap. 1, para. 1). According to AAOS, the risk of foot illness can be reduced by wearing properly fitting shoes that conform to the natural shape of the feet. A women's shoe survey conducted by the American Orthopaedic Foot and Ankle Society (AOFAS) indicated several findings on how women wear shoes (Frey et al., 1993). First, nine out of ten women wear shoes that are too small for their feet.

Second, eight out of ten women say their shoes are painful. Third, more than seven out of ten women have developed a bunion, hammertoe, or other painful foot deformity. Fourth, women are nine times more likely to develop a foot problem because of improperly fitting shoes than men. Lastly, nine out of ten women's foot deformities can be attributed to tight shoes. In another study on woman shoe wear and foot disorder, 87% of the surgical procedures for forefoot were conducted for women and 13% for men (Coughlin, 1996). In the surgical procedures for other parts of foot which are not obviously related shoe wear, there was no difference in the incidence between men and women. This study showed that many surgical procedures could be avoided when they wear roomy and comfortable shoes. In a survey of over 1,200 runners conducted by AOFAS, almost two thirds of respondents had injuries related to their shoes (American Orthopaedic Foot & Ankle Society). In this survey, the most commonly reported injuries were blisters, tendonitis, arch pain, stress fractures, foot pain and toenail injures. The analysis of this study indicated that shoes conduct this protection function well when shoes are fitted to each runner’s feet.

Table 2.4

Walking Injuries and Shoes

Injuries	Symptoms	Relations to shoes
Corns	Small, round mounds of dead skin caused by friction.	In some cases, corns can be relieved by opting for shoes with softer uppers and toe boxes that are wider, longer, and higher.
Ingrown toenails	Nails, usually of the big toe, that curve inward along the edges of the nail bed, causing pain, redness, swelling, and even bacterial infection.	The symptoms can be aggravated by toe boxes that are too tight, so switching to a shoe with a wider toe box may help to relieve discomfort.
Bunion	A deformity of the big toe joint in which the joint juts outward and the big toe angles inward toward the other toes.	High-heeled shoes or shoes that are too tight in the toe area can aggravate the condition.
Hammertoe	A deformity in which a toe (or toes) hooks downward like a claw.	High heels or shoes that fit too tightly in the toe area can also cause the condition.
Neuroma	An abnormal collection of nerves that becomes irritated and inflamed.	Tight-fitting shoes can aggravate the condition.

Table 2.4 (cont.)

Injuries	Symptoms	Relations to shoes
Blisters	These pockets of clear fluid or blood Foot blisters are caused by friction.	Recommendations to prevent blisters are to buy high-quality shoes and make sure they fit properly, take good care of shoes, prevent shoes from getting brittle and stiff and break in new shoes before walking very far.
Callus	A thickening of the skin that results from pressure or friction.	To help relieve pain, try switching to a shoe with softer uppers and a roomier toe box.
Walker's heel	A group of heel problems that include bone bruises and heel spurs. The syndrome usually starts with pain at the base of the heel, which involves inflammation of the tissues that attach to the bottom of the heel bone.	These ailments may be worsened by walking in poorly designed or worn-out shoes. One treatment can be to switch to a shoe that has a springy rubber sole and a slightly higher heel.

Table 2.4 (cont.)

Injuries	Symptoms	Relations to shoes
Achilles tendon injuries	The Achilles tendon is the thick tendon at the back of the leg that connects the heel and foot to the back of the calf muscles. It controls the hinge like action of the ankle.	Tendons can become inflamed as a result of ill-fitting shoes. When the heels is be too low or too hard, the backs may be so tight that they irritate or strain the tendon, or the arch support in the shoes may not be adequate. Choosing a walking shoe with a slightly higher heel or inserting a sponge pad in the heel section of your shoes can help prevent the pain of Achilles tendinitis and of heel spurs.

Note. The table is created based on Boone, 2007.

Fashion Function of Athletic Shoes

Since medieval times, shoes have been influenced by fashion (Tyrrell & Carter, 2009). Pointed shoes were popular at that time. In the thirteenth century, high-heeled shoes were developed and became popular, specially for women. In the Elizabethan era, British people wore highly decorated shoes which had uppers of embroidered satin. Many shoe styles such as clogs, court shoes, boots, flip-flops which are more

familiar in present times were developed a long time ago, in the 17th and 18th centuries or even in 1000 and 2000 BC, and have changed little as they reappear in various ways over times. Still, the major reason people wear shoes is protection, but fashion gained more importance as another reason in recent days (Tyrrell & Carter, 2009).

History and Culture of Athletic Shoes as Tie-Symbols

In terms of fashion function, walking shoes—athletic shoes for walking—share the story of athletic shoes. Athletic shoes as part of American culture, Vanderbilt (1998) said that "follow its footprints carefully, for they run straight through the heart of American culture, across the global economy, and along the contours of contemporary history" (Vanderbilt, 1998, p. 2). Especially for the young, he states, "the sneaker was an integral part of the first distinctive marketed youth fashion and cultural movement in American history" (p. 13).

One of the functions of fashion is identification (Rubinstein, 2001). For example, teenagers often select the same dress styles worn by their favorite celebrities such as movie, music and sports stars. Wearing similar clothing creates a bond between teenagers and the stars. Clothing symbols can indicate that one belongs to a certain group and members can identify each other (Rubinstein, 2001). Rubinstein defines that tie-symbols are expression of support or association with a particular idea, cause, predicament, or person.

In history, athletic shoes were adopted by the young as tie-symbols. The shoes are given the name sneakers because the soles are so smooth and they do not make

any sound on the ground. Since the early part of the 20th century witnessed the birth of many of the familiar sneaker brands, such as Ked, Converse and Adidas, sneakers remained the domain of athletes until Hollywood picked up on the fashion. In 1950's, sneaker style was officially sanctioned when teen icon, James Dean, was photographed wearing his Levis jeans and white sneakers. From then on, sneakers became the preferred shoes of teenagers and the symbol of rebellion. In the 1970's, the culture of athlete endorsement was on the rise. The 1976 Montreal Olympics was the first time an athlete was photographed endorsing his running shoes after winning 10,000 meter race. In 1973, track athlete Steve Prefontaine became the first major track person to wear Nikes. In 1976, Jimmy Connors won Wimbledon and U.S. Open wearing his Nike tennis shoes. In 1978, John McEnroe signed an endorsement with Nike. By the 1980s, sneakers were everywhere; Woody Allen wore them to the ballet, and Dustin Hoffman wore them while playing reporter Carl Bernstein in the movie "All the President's Men". "The 1981 movie 'Fast Times at Ridgemont High', with Sean Penn's character wearing Vans checkerboard slip-ons, created considerable demand for these high-selling skateboard shoes. As a result, Vans became a leader in extreme-sports shoes" (Pribut & Richie, 2002, para. 3).

The shoes originally developed for sports became the mainstay for most people. Nike and Reebok were among the market leaders. Newer brands went in and out of fashion, and sneaker companies started making major endorsements to players. In 1985, the first major line of sneakers was endorsed by Chicago Bulls player, Michael Jordan (Vanderbilt, 1998). After that, the Jordan line, to date, has spawned many

versions of Air Jordans. It is one of largest endorsements for a contract with Nike to make his own signature line of shoes and apparel. The 1990's and the first part of the 21st century were all about celebrity endorsements and limited editions. Nike's Jordan brand released retro editions of the classic Air Jordans and continued to release new models. Nike kept going strong to release a revolution cushioning system called Nike Shox. Reebok, in a bid to strengthen their sales, forms an unheard of partnership with various music artists to create their Sound and Rhythm line. Rubinstein (2001) mentioned in his book "Dress Code" that it has become a common practice to focus advertising to teen age and young adult consumers. These advertisements are intended to make consumers follow the people endorsing the product.

Technical advances allow people to break from past appropriate identity which has become inappropriate in present (Rubinstein, 2001). "Innovations in style and fabric made it possible for members of a group to appear "cool," as if unaffected by passion, agitation, or alarm; and it enabled wearers to acquire confidence, reflecting the new spirit" (p. 269), Rubinstein said. Athletic shoes were technically upgraded with the introduction of new lightweight material and foam composite (see Figure 2.1 and Table 2.3). As Vanderbilt noted "Those shoes were better than they had been, in terms of weight and cushioning, and by the 1980s, athletic shoes set the standard for all shoes" (p. 23), and athletic shoes were part of a "cool" life style. "Extreme shoes" in 1998-1999 were introduced as an example of tie-symbol by Rubinstein (2001). He explained that "They were based on the technology of athletic shoes … Combined with

features of dress shoes … resulting shoes were stylish enough to wear to the office" (p. 269).

Which Shoes Do Consumers Actually Buy for the Purpose of Walking?

Specialty walking shoes are developed for the specific purpose to provide proper protection functions for walking activities—fitness and long distance walking. Specialty walking shoes make walking feel easier. They are specifically designed to help propel the walker through the heel-toe motion of the proper walking technique. This is why specialty walking shoes work better for walkers than do running shoes. While walkers are supposed to wear walking shoes for walking, most people do not buy specialty walking shoes for walking purposes. Rather, they buy various categories of athletic shoes, which will be discussed in the following sales reports.

Sales Reports of Athletic Shoes

The sales reports on athletic shoes indicate that most of consumers buy not specialty walking shoes but rather other categories of athletic shoes to wear for exercise walking. According to the National Sporting Goods Association (NSGA)'s 2006 sale report (see Table 2.5), most purchased categories were walking (27.9%), gym shoes/sneakers (16.3%), jogging/running (15.6%), cross-training (10.19%), hiking shoes (6.79%), and basketball (6.55%) shoes. But according to the 2006 sales report (see Table 2.6) provided by NPD group Inc., the leading provider of consumer and retail information, most selling categories of athletic shoes were running (25.4%), low performance (24.4%), basketball (15.1%), cross-training (6.2%), skate (5.8%), and walking (8th in the sales ranking, 4.1%). In terms of athletic shoe categories, running

shoes and low performance shoes, which was branded as "athleisure (athletic + leisure)" shoes by NPD, sold the most, and specialty walking shoes were included in the four lowest selling categories. Similar sales results were reported in SGMA (Sporting Goods Manufacturers Association)'s 2004 report: the four best selling categories were running (28%), basketball (23.3%), cross-training (9.6%) and low performance (6.9%), and walking shoes were only 5.4% (Pribut & Richie, 2004).

Table 2.5

2006 Sales Figures and the 2001-to-2006 Growth Rate for Athletic Shoes Categories (Source: NSGA)

Athletic shoes Categories	Sales in 2006	5-yr. Growth
Walking	$4.1 billion	24%
Gym shoes/sneakers	$2.4 billion	20%
Jogging/running	$2.3 billion	35%
Cross training	$1.5 billion	no change
Hiking shoes/boots	$1.0 billion	11%
Basketball	$964 million	27%
Fashion sneakers	$889 million	n/a
Sport sandals	$589 million	14%
Tennis	$505 million	no change
Fitness shoes	$474 million	44%

Note. The table is adapted from Richard, 2007, p. 29.

Table 2.6

The Athletic Shoes Sales (Source: NPD Group) in 2005 and 2006

Athletic shoes categories	Sales in 2005	Sales in 2006	Changes
Total	$18,860,428	$19,336,351	2.5
Running	$5,033,926	$4,906,945	-2.5
Low performance	$4,519,512	$4,716,290	4.4
Basketball	$3,021,224	$2,912,662	-3.6
Cross training	$1,200,580	$1,198,906	-0.1
Skate	$771,161	$1,118,709	45.1
All other performance	$980,615	$1,117,478	14.0
Hiking	$810,210	$830,999	2.6
Specialty Walking	$769,724	$784,178	1.9
Tennis	$623,189	$603,211	-3.2
Sport sandal	$471,686	$483,533	2.5
All other	$658,602	$663,441	0.7

Note 1. The table is from The NPD Group Inc, 2007, category dollar by volume.

Note 2. "All other Performance" means athletic performance, such as volleyball and soccer, not listed in the categories of the table.

Note 3. "All other" means any category not listed in the table.

Basically, this difference among major sales reports comes from the data collection methods. NSGA's data are collected based on retail sales in the U.S. projected from consumer interviews. NSGA's report tells us for which purposes customers bought athletic shoes. Different data are used for NPD's sales reports. The services which the NPD group provides include consumer surveys and retail tracking for U.S. and European companies. The NPD consumer data come from the online panel of more than 3 million consumers. NPD's report explains which categories of athletic shoes customers actually bought. SGMA's data are based on manufacture's sales by category report. SGMA's report provides similar information using a different source of the data than NPD's report do.

These sales reports show which categories of athletic shoes people actually bought for walking. In terms of purchasing purposes based on NSGA's sales reports, specialty walking shoes sold the most, which is supported by the fact that walking is most popular activity among all fitness and sport activities in the NSGA and SGMA's sports and fitness participation report (see Tables 2.1 and 2.2). Regardless of specific categories, most consumers bought various types of athletic shoes for their walking purposes. From NPD and SGMA's sales report, specialty walking shoes sales were only 4 to 5% of athletic shoes market. This means that though people bought athletic shoes for walking purposes, most of them purchased non-athletic shoes specially made for walking but rather other categories of athletic shoes such as running, training and so on. According to the fitness activity participation reports, three times more people participate in walking than running. The sales figure, to the contrary, show running

shoes sold five times more than specialty walking shoes. This implies that many people bought running shoes for purposes other than running, such as walking. Based on those sales reports and fitness and sports participation reports, it can be said that consumers do not care about which category of athletic shoes they buy for walking. They select various kinds of athletic shoes based on their preferences.

Market Trend of Athletic Shoes

The other part of this story can be explained by athletic shoe market trends. In the athletic shoe market, the fashion function plays a major role. The athletic shoes market trend has changed from athletic/performance shoes to comfort and style/fashion shoes recently. In the article called "NPD Sees Fashion Focus Driving Athletic Shoes Sales," Marshal Cohen, the chief industry analyst of NPD group, a leading provider of consumer and retail information stated as follows:

> There is a clear shift by consumers from casual athletic shoes to fashion designs for casual … A huge part of the athletic shoes market is not comprised of hard core users. … There's a shift in what consumers want in their active footwear… Consumers are telling us that style and comfort, not performance, are the keys here. (The NPD Group Inc, 2007, para. 2-3)

In another athletic retail market report called "Strong Fashion Orientation of Athletic Retail Market," Koncept Analytics (2007) mentioned that "Majority of spending on athletic apparel and footwear is not intended for athletic activities, but for comfort and fashion" (para. 1). Concerning athletic shoe trends, Pribut and Richie (2004) said that fashion has become an important factor as much as function is in selecting

athletic shoes. Based on the market trends and the sales reports, it can be said that there is no big difference in selecting categories of athletic shoes for walking purpose and nonathletic purposes. People select various types of athletic shoes for walking in the similar way as they choose athletic shoes for nonathletic purposes without considering specific categories of athletic shoes according to their preferences. In large retail athletic shoe stores such as *Foot Locker* and *Finish Line*, there is basically no section for specialty walking shoes in the stores.

How to Select Walking Shoes

When people select walking shoes, they consider many shoe attributes. Those shoe attributes can be divided into two major categories: quality-related and non-quality-related attributes. When selecting walking shoes, most consumers think that quality-related shoe attributes, such as comfort and fit, are more important than non-quality-related shoe attributes, such as fashion, brand, and technical feature. In actual purchase, however, consumers often make choices according to non-quality-related shoe attributes.

Considering Quality of Shoes: Comfort and Fit

Though consumers choose various categories of athletic shoes for their walking, still they should select proper shoes which can provide the good protection function. “In general, they should select shoes that fit well, are comfortable and with cushioning that feels neither too hard nor too soft. Subjective assessments of fit, comfort and shock attenuation are generally reliable guides to the actual mechanical properties of the shoes” (Shorten, 2000, p. 166). Concerning comfort and fit as two key factors

which need to be considered in choosing quality shoes, Pribut and Richie (2004) stated that “whether for casual use or for a high performance sport, the choice of shoes can be critical for the comfort … proper fit should supersede all other concerns” (p. 86).

Tyrrell and Carter (2009) defined that “Comfort is a relative term which relates to a lack of discomfort or pain … ‘comfort’ may mean different things to different people” (p. 13). Relating comfort to fit, they described that “For a shoe to fit, it ought to allow a certain ‘feel’ against the foot so that the wearer knows they have a shoe on their foot, but it should not cause any discomfort or pain or trauma” (p. 14). Langer (2007) defined “comfort” in his article as very personal and subjective. “Comfort is so personal and subjective that it is almost impossible to define. … our gait is as unique as our voice and we all have certain movement patterns” (p. 14). In his article, he talked about two interesting studies conducted at the University of Calgary. The results of one study suggested that “if a shoe works with our movement patterns, it will feel more comfortable and help us move more efficiently, which delays fatigue and makes us less vulnerable to injury” (p. 14). The other study showed that “the runners were most efficient (higher VO_2 max) in the shoes that they had rated as most comfortable. The results of this study suggest that runners possess some sort of inherent sense of efficiency that is linked to what they perceive as comfort” (p. 14). As a podiatrist, Langer gave some advice on shoe comfort, “I always remind my patients when trying on shoes to trust their instincts about comfort—emphasizing that if one shoe feels natural or less conspicuous than another shoe, then it is probably working with their gait” (p. 14). Yet, it is very difficult for consumers to figure out comfort. As a practical

way of selecting comfortable shoes, Langer (2007) recommended to select comfortable shoes by comparing at least several shoes based on major activities designed for the shoes.

Concerning *fit*, Tyrrell and Carter (2009) discussed as follows:

> Shoes should fit the feet they are intended for. The heel part of the shoe upper grip the calcaneus and hold the foot at the back of the shoe. The shoe should flex where the foot is designed to flex—at the metatarso-phalangeal joints. The foot should have to make no effort to keep the shoe on and the outer sole should provide enough grip to prevent the foot slipping as the individual walks and runs. (p. 14)

In terms of shoe fit, there are three recommended checking points in athletic shoes: toe, width, and heel. In the toe, the rule of thumb is to allow thumbnail's length of space between top of longest toe on largest foot and end of the shoe. In terms of width, it is recommended that foot should fit comfortably without stretching the upper of a shoe. In the heel, the checking point is that heel can move but is not slip.

Considering Other Attributes Together: Fashion, Price and Brand

In actual purchases of walking shoes, it is recommended that consumers choose quality shoes that provide good comfort and fit for their feet also considering other attributes such as fashion, price, and brand together. They do not have to sacrifice fashion to find comfortable shoes, which fit well. Shoe manufacturers are producing shoes in many colors and from different materials to appeal to consumers'

desires for fine looking and comfortable walking shoes. Consumers can select comfortable and well-fitting shoes that look good to them.

In terms of price, high price does not guarantee high quality in the athletic shoe market. High price may be related to more technical features than high quality. In a study evaluating the performance of athletic shoes during walking and running on a treadmill, the results of the study demonstrated that low- and medium-cost running shoes in each of the three brands tested provided the same (if not better) cushioning of plantar pressure as high-cost running shoes (Clinghan et al., 2007). They also said that comfort is a subjective sensation based on individual preferences and is not related to either the distribution of plantar pressure or cost. In a survey study, Marti (1989) studied 5,038 runners who participated in a 16km race and had them fill out an extensive questionnaire about their running in the year preceding the race. In this study, the incidence of injuries in runners using expensive shoes was higher than that in runners using cheaper shoes. The result was opposite to what is expected. Consumers do not have to buy high priced shoes to get high quality shoes in comfort and fit.

Athletic footwear companies live and die by their perceived brand image in the marketplace. These companies expend considerable effort and resources attempting to convince customers that athletic shoes made by other companies are imperfect substitutes. Athletic shoe companies accomplish their brand images using various kinds of advertising, distribution outlets, and grassroots marketing. Brand images of major athletic shoe manufactures are the followings: Nike shoes are considered to be

of good quality and stylish, Reebok are comfortable and casual, and Adidas boasts superior performance (Kang, 1996).

Brand image helps athletic shoe manufacturers to establish loyalty by imposing multi-dimensional characters on the product and by deflecting consumer attention away from price (Brassington & Pettitt, 2000). Consumers associate themselves with a particular brand and tend to stick to that brand with which they feel comfortable. Brand loyal consumers tend to be consistent purchasers, holding strong perceptions in relation to the quality of the brand they buy (Hoyer & MacInnis, 1997). Those consumers believe their favorite brand best meets their overall needs (Hawkins, Best, & Coney, 2001), and they therefore commit and form an emotional attachment to that brand (Hawkins et al., 2001; Mowen & Minor, 1998).

While for athletic shoe manufacturers, brand loyalty is a crucial factor for their successful business, brand loyalty could be a risky thing for consumers especially if it is formed based on insufficient information on all other brand shoes. Brand loyal consumers tend to restrict their selections to their preferred brands. Those consumers do not show interests in other brands and do not switch to other brands (Wakefield & Barnes, 1996). From the beginning of shoes selection procedures, brand loyal consumers might exclude best alternatives (of non-preferred brands) that would be included in their consideration if they were not loyal to specific brands. When consumers put too much importance on brand, they can lose the chance to buy better shoes. Those consumers can also be taken advantage of by companies that spend too

much money to cultivate good brand images and to transfer this excessively spent money to consumers. Brand should not be a driving factor in choosing walking shoes.

Selecting Quality Walking Shoes: Problems and Challenges

Selecting proper walking shoes is not an easy task because of two difficulties: too many choices of athletic shoes, which can be used for walking and multiple shoe attributes, such as price, design, brand, comfort, and so on, which need to be considered together to evaluate alternatives. Because of these difficulties, people choose walking shoes only considering one or two attributes among limited number of athletic shoes. There are possibilities that their actual choices are different from the selections that they mean to make.

Problems in Selecting Quality Walking Shoes

Concerning athletic shoe research, there have been two major research groups —biomechanical research and marketing research. The role of research is different between biomechanics and marketing (Pribut & Richie, 2004). Biomechanical research developed technical features and provided valuable knowledge for the quality of athletic shoes. Marketers looked for the technical features that consumers are interested in and pay attention to. Those marketers accepted technical features that could be only helpful for increasing sales. In the athletic shoe market, marketing plays a major role in making the trends and biomechanics supports marketing. “Sneaker companies have gone from being manufacturing-driven companies to marketing-driven companies” (Vanderbilt, 1998, p. 4).

Athletic shoe companies roll out on average four new lines a year, each batch loaded with new colors, styles, and technical features that make athletic shoes look cool, but actually may not make a big difference in shoe quality—all of which are often replaced the following year (Vanderbilt, 1998). In a crowded market where distinguishing features are scant, design—style and fashion—has become crucial for making a shoe stand out on the shelf and in consumers' minds. Among those technical features, which athletic shoes company have developed to improve shoes quality, most of those features were tricks, which made athletic shoes more expensive (Pribut & Richie, 2004).

Technical Features as a Marketing Tool

Though technical features do not do much for quality, they were a good tool for marketing. Vanderbilt (1998) explained about how technologies worked for marketing as follows:

> Sneaker [Athletic shoe] companies tried to develop advanced technologies for their athletic shoes for top athletes as standard-bearers, which sounds reasonably advanced and makes sense to normal consumers. Whatever edge is gained is purely in the realm of perception; as a 1997 Salomon Brothers industry report put it, "No company has publicized that its cushioning systems outperforms another because generally these cushioning technologies perform no better than regular polyurethane (PU) or ethylene-vinyl acetate (EVA) form. Investing in the creation and strong marketing of these technologies provides credibility to companies that their products will actually help with true athletic

performance, and thus help give a specific brand an aura of being an authentic athletic brand" (p. 52).

Based on this perception, people believe that athletic shoes are technically advanced and have good quality (Vanderbilt, 1998). When people look for quality shoes which are comfortable, well-fitting, and high performing, it is natural that they select athletic shoes. As mentioned in the athletic market trend reports, major portions of consumers do not buy athletic shoes for any fitness and sports activities. Still, they care about shoe quality—comfort and fit. In 2008's report by the NPD group, when responding to the survey question, "Why did you choose this brand of athletic shoes?", consumers said that comfort and fit was the primary influence on their athletic shoes purchases. Fashion and style were placed second as purchase influencers. In terms of the preference of specialty walking shoes (athletic shoes specially designed for exercise walking), Bumgardner (2008) conducted the poll through the internet with the question, "What do they look for?" The result of the poll was very similar to the NPD's survey result. Comfort and fit was the first and second most frequent answers. There is no difference in consumers' purchasing behaviors between athletic shoes and specialty walking shoes.

Discrepancy between Perceived and Actual Choices

In actual purchases, most consumers do not care much about which category of athletic shoes they wear for walking. They buy various types of athletic shoes for walking according to their preferences in fashion, price, or brand assuming that athletic shoes are good for walking. They do not make serious efforts to find proper

shoes specifically for walking, which can provide optimal comfort and fit for their feet. It is natural that consumers' choices are distracted by fancy, expensive and technical athletic shoes. The expected problem is that there is a high possibility of discrepancy between their actual choices and their perceived choices—the choices they mean to make. They could choose better shoes than what they actually choose for their feet. If they were not distracted by technical and fancy features, their actual choices could be different. Also they may be paying more than quality walking shoes actually cost.

Challenges in Selecting Walking Shoes

Complexity of Selecting Walking Shoes

The discrepancy between actual and perceived choices is closely related to the complexity of selecting quality walking shoes. If there are only several shoes available in the market and consumers choose one of them considering only one shoe attribute such as price or brand, the discrepancy between actual choice and perceived choice would not happen. Actual conditions for selecting walking shoes are very complicated. There are many choices of athletic shoes available in the market and multiple attributes need to be considered to compare alternatives. Because of cognitive limitation, a consumer as a decision maker may rely on simplified rules of thumb in the process of information to arrive at his or her final decision (Newell & Simon, 1972; Simon, 1987). When simplified rules of thumbs applied to actual purchase of walking shoes, expected problem is that people have trouble understanding what factors are relevant to a given decision-making situation, which can cause radical in a short period of time (Jones, 1994). Due to cognitive limitation resulting from complicated

conditions for purchasing walking shoes, consumers can be influenced unexpectedly or distracted by one or two conspicuous attributes such as fashionable designs and advanced technical features.

Characteristics of Selecting Walking Shoes

The complexity of decision making depends on two factors: the number of alternatives and attributes. As the number of alternatives and attributes gets larger, decision making becomes harder and more complicated (Mintz et al., 1997; Olshavsky, 1979; Schwartz, 2000). The impact of number of alternatives and attributes are described below.

Too many alternatives. A distinctive characteristic of athletic shoe selection is that there are too many choices. Athletic shoe experts say that "From cushioning to varying degrees of promotional control, from straight lasts to curved lasts, from wide to narrow and from the latest and greatest shoes to classic models, we have the largest amount of choices ever available" (Pribut & Richie, 2004, p. 97). Concerning new athletic shoes design coming out in the market, Vanderbilt (1998) mentioned that "In recent years, the design turnover is so fast that, as a Brooks marketing employee remarked, "I can't imagine what the shoe would like in ten years if they went at this rate"" (p. 50). There are too many athletic shoes and their designs changes too often for consumer to get enough information on athletic shoes available in the market. Consumers need to select optimal shoes for their feet using limited information on athletic shoes. They must factor the decision to make it manageable, examining only

relevant aspects (Jones, 1999). They need to have a proper strategy to handle this difficulty.

Multiple attributes. In evaluating alternatives, decision makers need to compare them across all important attributes. Difficulty in evaluating alternatives depends on how many criteria are considered. It is difficult to make comparisons between alternatives comprehensively, with respect to all criteria (Roy, 1993, 1996). In selecting athletic shoes, consumers need to consider multiple decision criteria such as comfort, fit, technical features, price, style and brand. In multi-attribute situations, people often have severe difficulties even in making compensations that look so simple in consumer choice theories (Jones, 1999). Therefore, they tend to use a variety of shortcuts that avoid making the direct tradeoffs. In making trade-offs (or also compensations), all of the attributes are considered in comparing alternatives and a high value in one attribute can compensate for a low value on another attribute. Typical method is that attribute values are summed up across all attributes and the highest valued alternative is selected. Consumers need to have a strategy—how to compensate multiple criteria in evaluating alternatives—to take care of these conflicts.

Finding Solutions for the Problems and Challenges

There has been no study for providing solutions for the problems and challenges in selecting walking shoes as discussed above. The solutions for reducing the discrepancy between actual and perceived choices could be sought in decision making studies.

Decision Making

There have already been many studies on decision making, which provided solutions for the problems and difficulties happening in various kinds of decision making procedures. Selecting walking shoes is a typical consumer decision making situation in which consumers make a choice among many alternatives by evaluating alternatives with respect to multiple criteria (attributes).

Definitions in Decision Making Studies

To help describe the decision making, commonly used terms in that area are summarized in Table 2.7.

Table 2.7

Definitions of Words Frequently Used in the Decision Making Literature

Words	Definition
Information	This is knowledge about the decision, the effects of its alternatives, the probability of each alternative, and so forth. A major point to make here is that while substantial information is desirable, the statement that "the more information, the better" is not true.
Alternatives	These are the possibilities one has to choose from. Alternatives can be identified (that is, searched for and located) or even developed (created where they did not previously exist).

Table 2.7 (cont.)

Words	Definition
Goals	These are overall objectives decision makers want to achieve. The first thing decision makers are supposed to do is to figure out what their goals are.
Criteria	These are the characteristics or requirements that each alternative must possess to a greater or lesser extent. Usually the alternatives are rated on how well they possess each criterion. Attributes are called criteria in decision making. In AHP method, criteria can be classified into several levels, such as criteria, sub-criteria, sub-sub-criteria, and so on.
Value	Value refers to how desirable a particular outcome is, the value of the alternative, whether in dollars, satisfaction, or other benefit.
Preferences	These reflect the philosophy and moral hierarchy of the decision maker. They are the decision maker's personal values. Decision makers can make different decisions based on their preferences in the same decision making situation. Some people prefer quality to quantity, fashion to quality, price to comfort, and so on.
Decision quality	This is a rating of whether a decision is good or bad. A good decision is a logical one based on the available information and reflecting the preferences of the decision maker.

Note. The table is created based on Harris, 2008, “Concepts and Definitions”.

Bounded Rationality in Decision Making

Though human behavior is intended to be rational, a decision is rational only in a restrictive sense because it depends on the decision maker's capacity to collect and analyze information (Simon, 1987). According to rational choice theory or rational action theory, it is assumed that people select the best action according to consistent preference functions and constraints facing them (Simon, 1987). Decision makers need to have enough information to make rational choices among alternatives. It is, however, impossible for decision makers to process all available information to make decisions because of their cognitive limitation. Actually, decision makers become not rational but rationally bounded in their decision-making (Simon, 1955; 1956; Newell, & Simon, 1972). People may rely on simplified rules of thumb in the process of information to arrive at their final decisions (Simon, 1955). According to decision-making conditions, decision makers are supposed to use different rules or strategies to make their decisions.

Decision Strategy

Decision strategies are contingent on decision making situations. Decision strategy is about how to compare alternatives with one another and select the best option based on comparison results (Payne et al., 1993). Human beings are adaptive decision makers in the sense that they can apply different decision strategies and switch between them depending on the characteristics of the decision task, such as the numbers of alternatives and criteria (Beach & Mitchell, 1978; Payne, 1982; Takemura, 1985). Compensatory and non-compensatory strategies have been

identified as two modes of information integration according to whether trade-offs—also called compensations—among criteria is used or not (Billings & Scherer, 1988; Ford, Schmitt, Schechtman, Hults, & Doherty, 1989; Payne et al., 1988, 1993; Todd & Benbasat, 1999).

In compensatory strategy, all of the criteria are considered in comparing alternatives and a high value in one criterion can compensate for a low value in another criterion. A typical method is that attribute values are summed up across all attributes and the highest valued alternative is selected. Contrary to compensatory strategy, in non-compensatory strategy, decision makers do not make trade-offs between high values and low values across criteria. Generally partial information among all available information is used and alternatives which do not meet the threshold value for the considered criteria are eliminated.

Non-compensatory strategy can be used to reduce the number of alternatives to be carefully evaluated and therefore improve the processing effectiveness (Payne et al., 1993). The studies on non-compensatory strategy began as an interest in the cognitive and psychological processes of decision making (Einhorn, 1970, 1971; Olshavsky, 1979). The research found that as the decision tasks became more complicated, decision makers employed more non-compensatory strategies. Specifics of these strategies, as well as their advantages and disadvantages, are described below.

Two-Stage Choice Strategy for Consumer Decision Making

When a consumer makes a choice among a lot of alternatives, they usually use two-step strategy. Before making a choice in the second step, many alternatives are

reduced to a manageable level in the first step. Non-compensatory strategy is used for the first step and compensatory strategy is used for the second step.

Two-Stage Choice Strategy

Phased decision strategy is likely to be used when the number of alternatives is large (Bettman, 1977). Decision makers use the two-stage choice strategy, in which non-compensatory approaches come first and then compensatory approaches follow (May, 1979; Parkinson & Reilly, 1979). In the first stage, decision makers try to make a smaller alternative set by eliminating alternatives below threshold values in one or more particular attributes (Ben-Akiva & Boccara, 1990; Wright & Barbour, 1977). In the second stage, after the reduced set of alternatives reaches to a manageable level, they applied a detailed analysis in evaluating the remaining alternatives (Wright & Barbour, 1977).

Two-stage choice strategy reflects characteristic of decision making in the context where consumers have to cope with complexity (Wright & Barbour, 1977). In the process of consumer decision making, decision makers follow the sequence of stages during which number of alternatives decreases till they make a final choice (Kotler, 1988; Roberts, 1990; Roberts & Lattin, 1991).

Consideration Set for the First Stage

As a result of the first stage of two-stage choice strategy, a small and manageable set of alternatives are chosen. This set is called consideration set (Brisoux & Laroche, 1981; Laroche et al., 2003; Narayana & Markin, 1975). The purchase decision is limited to the alternatives within the consideration set (Howard & Sheth,

1969). Consideration sets can be evaluated thoroughly with compensatory approaches in the second stage of decision making.

Two types of risks in the process of making consideration set. According to Keller and Staelin (1987), there exist two types of risks in forming a consideration set. The first risk is that decision makers might easily eliminate alternatives that need to be included in the consideration set. As a result of the first risk, they cannot reach an optimal consideration set which includes all qualified alternatives. The second risk is that decision makers can include alternatives which need to be excluded from the consideration set. As a consequence of the second risk, the efforts used to find unnecessary alternatives are wasted. The first and second risks compensate each other in making a consideration set. The more alternatives, the lower the first risk but the higher the second risk. The goal in making a good consideration set is to select a manageable number of alternatives that need to be included in the consideration set.

Proper number of alternatives in a consideration set. There have been studies about the proper number of alternatives in a consideration set (Brown & Wildt, 1992; Laroche, Rosenblatt, Jacques, & Roberts, 1983). Hauser and Wernerfelt (1990) summarized the evidence regarding size of a consideration set. In their summary, the mean or median of consideration sets for various products ranged from two to eight with most frequent size in the range of three to six. There could be some difference in the size of a consideration set by products. In the studies, the mean consideration sizes by four different products were 5.39 for fast food, 5.06 for soft drinks, 2.98 for gasoline and 5.4 for all together. This result indicates that the larger the available

alternatives, the larger the consideration size. Psychological studies also support these numbers. The maximum number of input data that humans can seem to grasp mentally is approximately seven (Miller, 1956). Based on the studies related to the number of alternative in a consideration set, it can be said that the number of alternatives needs to be reduced to around five to reach a final decision.

MCDM (Multicriteria Decision Making) for the Second Stage

In the second stage, decision makers apply a detailed analysis—compensatory strategy—in evaluating reduced alternatives to make a final decision. The decision contexts of the second stage are that a choice needs to be made among a limited number of alternatives considering multiple criteria. “As defined by the International Society on Multiple Criteria Decision Making, Multi-Criteria Decision Making (MCDM) is the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process” (International Society on Multicriteria Decision Making, n.d., para. 1). Multicriteria decision making consists of three components: decision goal, decision criteria, and alternatives. The purpose of decision making is to help a decision maker to make a choice among alternatives based on the preference. The aim of MCDM method is to provide help and guidance to the decision maker in discovering the most desired solution to the problem—in the sense that this course of action best achieves the decision maker's long-term goals (Stewart, 1987, 1992). According to Stewart (1992), there are two assumptions for MCDM. The first assumption is that there is always scope for some forms of compensation between attributes. The second assumption is

that there exists a true ordering of the alternatives (and by implication a best alternative) representative of the decision maker's preferences, which needs to be discovered.

Difficulty in MCDM contexts comes from the fact that comparisons between alternatives must be made comprehensively, with respect to all criteria (Roy, 1993, 1996). In multicriteria decision making, priorities for the alternatives are generated by evaluating the criteria or sub-criteria (Stewart, 1988, 1991). The alternatives are ranked according to accumulated priorities across the criteria. The rank order can be used for choosing the best option and other purposes. Within MCDM, analytic hierarchy process (AHP), which has been used as a tool to overcome the difficulties of MCDM, shows a great potential for selecting walking shoes.

Analytic Hierarchy Process (AHP)

AHP is one of the most widely used MCDM tools. In this section, AHP will be discussed on what the theoretical backgrounds of AHP are, how AHP can be used in a real research, and how AHP has been applied to various research areas.

Three Functions of AHP

In dealing with MCDM of different types of data, AHP has three major functions: structuring complexity, measuring on a ratio scale, and synthesis (Forman & Gass, 2001). Concerning the first function, structuring complexity, Saaty (2001) found that human beings solve complicated problems by putting them into hierarchy structures in which they classify complex systems into several hierarchical levels and then simplify elements of each level into clusters with respect to the element—called parent—of

the adjacent higher level. This hierarchical structuring allows human beings to understand complex systems in a much easier way.

Related to the second function, measuring on a ratio scale, Saaty (2001) mentioned that "[AHP] is used to get ratio scales from both discrete and continuous paired comparisons in multilevel hierarchy structures" (p. 3). Concerning why ratio scales are required in calculating priorities (or preference and importance weights) hierarchical structures, Forman and Gass (2001) explained as follows:

> Any hierarchically structured methodology like AHP must use ratio scale priorities for elements above the lowest level of the hierarchy. This is necessary because the priorities (or weights) of the elements at any level of the hierarchy are determined by multiplying the priorities of the elements in that level by the priorities of the parent element. Since the product of two interval level measures is mathematically meaningless, ratio scales are required for this multiplication. (p. 470)

Due to the second function, measuring on ratio scales, different types of data can be dealt with together in AHP. There will be more explanation on the ratio scale in the sections of the principles and axioms of AHP.

In regards to the third function, synthesis, Saaty (1994a) explained that because of cognitive limitation, people have trouble in summing up measured scores over multiple levels and dimensions included in the hierarchy of a typical MCDM. Without help, decision makers may experience trade-off conflicts which prevent decision makers from properly calculating priorities of alternatives. Synthesis is a

required function for people to evaluate alternatives and calculate priorities according to their preferences. The three basic core functions need to work together step by step to help decision makers make quality decisions, which represent decision makers' preferences properly.

Basic Principles of AHP

Before describing the principles of AHP, three types of priorities—preference or importance weights—need to be defined: local, global, overall or ultimate priority. When determining the priorities of elements in a hierarchy of AHP, the three priorities are effective at different levels of a hierarchical structure of AHP. A local priority is relevant within a level of a hierarchy and a global priority is meaningful between levels of a hierarchy. Overall (or ultimate) priorities are applied only to alternatives. The final choice is made based on these priorities.

As basic principles for achieving the three major functions of AHP, Saaty (1994a, 2000) proposed three basic principles of AHP: decomposition, comparative judgments, and synthesis of priorities. According to Saaty and Vargas (2000), the decomposition principle is applied to hierarchical structuring of a complicated problem, in which there are three (minimum) or more hierarchical levels: the goal is in the top level, objectives are in the second level, sub-objectives are in the third level, and alternatives in the bottom level. In this hierarchy (see Figure 2.2), each element of the objective level as the parent is connected to one (itself) or more elements of the sub-objective level as children in a cluster. Each element of the sub-objective level as the parent is connected to one (itself) or more elements of sub-sub-objective level as children in a

cluster, and so on, until in the bottom level, each element of the second lowest level as the parent is connected to all of alternatives as children. In the whole hierarchy, member elements of a cluster need to be homogenous in terms of the parent, which is explained more in the axioms of AHP.

According to Saaty and Vargas (2000), the principle of comparative judgments is applied to make pairwise comparisons of all combinations of elements in a cluster in terms of the parent of the cluster. Local priorities of the elements in a cluster are calculated using these pairwise comparisons with respect to their parent. Ratio scale is derived from each pairwise comparison—relative comparison of two elements using the absolute scale (see Table 2.8) in terms of the parent.

Concerning the principle of synthesis, Saaty and Vargas (2000) explained that the global priority of an element is calculated by multiplying the local priority of the element by the global priority (or the local priority of the parent). In the objective level of a hierarchy—one lower level of the goal (top) level, the local priority of an element is the same with the global priority of the element. In the alternative (bottom) level, a local priority of an alternative is multiplied by the global priorities of every element of the parent level and then all these multiplied priorities are summed up into the ultimate priority for the alternative, which is the final result of AHP.

Axioms for AHP

AHP method is theoretically based on four relatively simple axioms: the reciprocal property, homogeneity, dependence, and expectations (Saaty, 1994a; Saaty & Vargas, 2000). The reciprocal property requires that $P_c(E_b, E_a) = 1/P_c(E_a, E_b)$, where

$P_c(E_a, E_b)$ is a paired comparison of elements "a" and "b" with respect to their parent "c". $P_c(E_a, E_b)$ means how many times more the element "a" has the property of the parent than does element "b" when the element "a" is expected to have more property of the parent than the element "b" does (Forman & Gass, 2001). For example, if "a" is three times more comfortable (in the property of "c") than "b", then "b" is one third as comfort as "a". If "b" is three times more comfortable than "a", then "a" is one third as comfort as "b". This axiom, basic in making paired comparisons, is required to derive ratio scales from pairwise comparisons. The reciprocal property allows for the construction of measurement scales of pairwise comparisons automatically into ratio scales.

The second axiom, homogeneity, states that "the elements being compared should not be different too much" (Forman & Gass, 2001, p. 471). If elements in a cluster differ much in terms of the parent, pairwise comparisons among them will tend to cause larger errors. When constructing a hierarchy of objectives and sub-objectives, elements need to be arranged in clusters so that differences among elements within a cluster are less than differences among elements between clusters. For example, in the case of college selection, if a SAT score is compared with "tuition" in terms of "quality of students", it is very difficult and likely meaningless to compare the two elements. If a SAT score is compared with "high school GPA" in terms of "quality of students", the comparison can be viewed as a proper comparison.

The third axiom, dependence, states that the lower level items depend on the adjacent higher level (Saaty, 1994a; Saaty & Vargas, 2000). In other words, the

priorities of the elements in a hierarchy do not depend on lower level elements. When calculating priorities of elements, pairwise comparisons are conducted among the elements in a cluster in terms of the parent located in the adjacent higher level. But the priorities of parents are not calculated based on the pairwise comparisons among the child elements located in the adjacent lower level. This axiom is important in applying the principle of hierarchic composition to real problems (Forman & Gass, 2001).

The last axiom, expectations, states that an outcome can only reflect expectations when the expectations are well represented in the hierarchy (Saaty, 1986). People who have proper reasons for their beliefs can represent their ideas adequately in the outcomes, which can then meet their expectations. Concerning the importance of this axiom, Forman and Gass (2001) mentioned that "While this expectation axiom might sound a bit vague, it is important because the generality of AHP method makes it possible to apply it in a variety of ways and adherence to this axiom prevents applying it in inappropriate ways" (p. 472).

AHP as Decision Support System (DSS)

DSS is any tool used to improve the process of decision making in complex systems, particularly where information is uncertain or incomplete (Silverman et al., 2001). Power and Sharda (2007) presented five generic categories of DSS based on the expanded DSS framework: communications-driven, data-driven, document-driven, knowledge-driven, and, model-driven decision support systems. According to their definition, "Model-driven DSS emphasizes access to and manipulation of a quantitative

model and hence the model or models are the dominant component in the DSS architecture that provides the functionality for the DSS. … The general types of quantitative models used in model-driven DSS include … various decision analysis tools including analytical hierarchy process" (Power & Sharda, 2007, p. 1945). As a model-driven DSS, "Expert Choice (www.expertchoice.com), an implementation of the Analytic Hierarchy Process (AHP), has been used in many DSS research studies" (Power & Sharda, 2007, p. 1047). Forman and Gass (2001) reported that "The World Wide Web address <http://www.ExpertChoice.com> contains references to over 1000 articles and almost 100 doctoral dissertations" (p. 469). In applying AHP method to selecting walking shoes, AHP works as a DSS by helping consumers to improve the process of making a choice of walking shoe.

Procedures of AHP

Saaty (2008) explained typical procedures of AHP for generating priorities with respect to the hierarchy as follows:

1. Define the problem and determine the kind of knowledge sought.
2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives).
3. Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.

4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weighed values and obtain its local or global priority. Continue this process of weighing and adding until the final priorities of the alternatives in the bottom most level are obtained. (p. 85)

In pairwise comparisons, the intensity of difference is measured using a 9-point scale (see Table 2.8) that indicate how many times more important or dominant one element is over another element with respect to the property of the parent in an adjacent higher level (Saaty, 2008).

Table 2.8

9-Point Scale for Pairwise Comparisons

Intensity	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
2	Weak or slight	
3	Weak importance of one over other	Experience and judgment slightly favor one activity over another.
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another.
6	Strong plus	

Table 2.8 (cont.)

Intensity	Definition	Explanation
7	Demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice.
8	Very very strong	
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation.
Reciprocals of the above	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.	
1.1 – 1.9	When elements are close and nearly indistinguishable	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

Note. The table was modified from Saaty, 2008, p. 86.

In the first step, the goal of a study is defined based on a problem. After that, the objectives for achieving the goal are decided. If expected to be available, sub-objectives are identified. In the end of this step, available alternatives are determined. This step is assumed to follow the fourth axiom. In the second step, the elements decided in the first step are composed into the structure of a hierarchy according to the principle of decomposition. This hierarchical structure is supposed to follow the homogeneity and dependence axioms. In the third step, based on the principle of comparative judgments, a set of pairwise comparisons for calculating each local priority in the next step are constructed into a matrix and each comparison in a matrix is measured using the 9-point scale. The reciprocal axiom should be followed in this stage. In the forth step, local and global priorities of all elements are calculated according to the principle of synthesis of priorities. The final results are ultimate priorities for all alternatives.

An Example of AHP Application to Getting a Job

To help understanding AHP better, an example in job application is illustrated below. In this example, the four step procedures mentioned above are followed to calculate the priorities of alternatives. This example is adopted from Saaty, 2008. In the first step, the goal, criteria (objectives), sub-criteria (objectives)—if expected to be available—and alternatives are decided as follows:

1. The goal is to determine the job which is best after getting a PhD.
2. The criteria selected to achieve the goal are flexibility, opportunity, security,

reputation and salary.

3. A group of sub-criteria for flexibility are location, time, and work; the group of sub-criteria for opportunity are entrepreneurial, salary potential, and top level position. Other objectives do not have sub-criteria.
4. Available typical types of jobs as alternatives are domestic company, international company, college, and state university.

As the second step, the hierarchy is constructed as in the Figure 2.2. The goal is located at the top level. Five criteria are located at the second level. At the third level, two sets of three sub-criteria are connected to two different parent criteria separately. Finally, at the bottom level, each alternative is connected to all nine elements—six sub-criteria and three criteria.

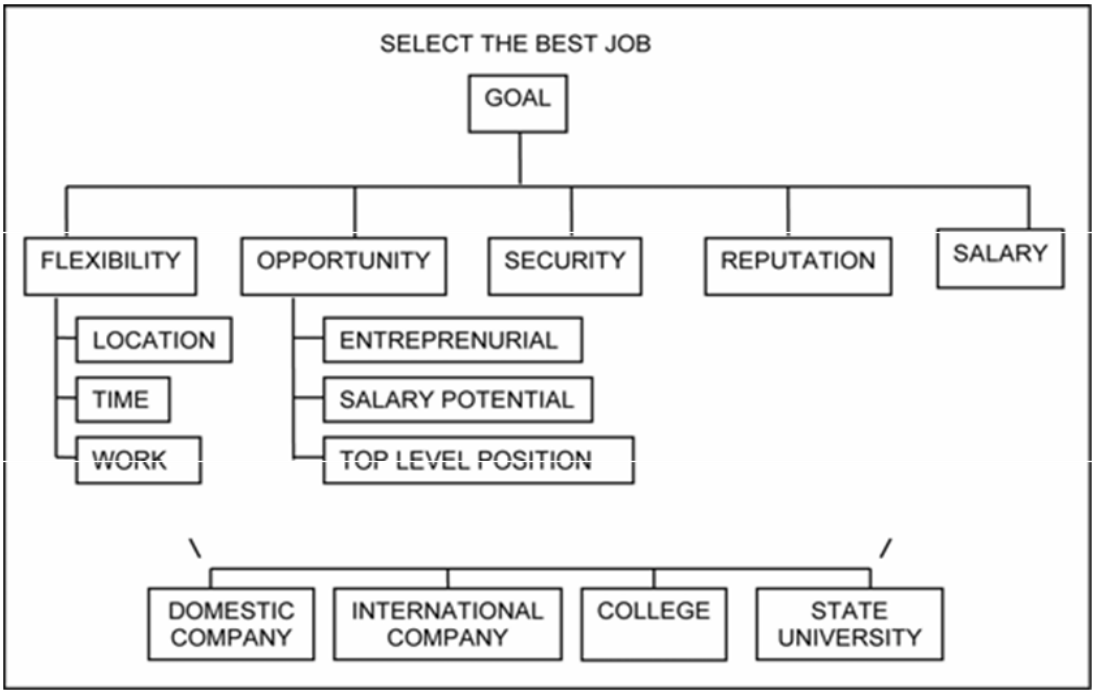
For the third step, Saaty (2008) explained how sets of pairwise comparisons are constructed into matrices as follows (the table names are changed according to the sequence of the tables of this thesis):

> There are 12 pairwise comparison matrices in all: One for the criteria with respect to the goal, which is shown here in Table 2.9, two for the sub-criteria, the first of which for the sub-criteria under flexibility: location, time and work, that is given in Table 2.10 and one for the sub-criteria under opportunity that is not shown here. Then, there are nine comparison matrices for the four alternatives with respect to all the 'covering criteria', the lowest level criteria or sub-criteria connected to the alternatives. The 9 covering criteria are: flexibility of location, time and work, entrepreneurial company, possibility for salary

increases and a top-level position, job security, reputation and salary. The first six are sub-criteria in the second level and the last three are criteria from the first level. We only show one of these 9 matrices comparing the alternatives with respect to potential increase in salary in Table 2.11. In Table 2.9, the criteria listed on the left are one by one compared with each criterion listed on top as to which one is more important with respect to the goal of selecting a best job. In Table 2.10, the sub-criteria on the left are compared with the sub-criteria on top as to their importance with respect to flexibility. In Table 2.11, the alternatives on the left are compared with those on top with respect to relative preference for potential increase in salary. (pp. 87-88)

Figure 2.2

Best Job Decision



Note. This figure is adapted from Saaty, 2008, p. 87.

Table 2.9

Pairwise Comparison Matrix of the Main Criteria with Respect to the Goal

	Flexibility	Opportunities	Security	Reputation	Salary	Priorities
Flexibility	1	1/4	1/6	1/4	1/8	0.036
Opportunities	4	1	1/3	3	1/7	0.122
Security	6	3	1	4	1/2	0.262
Reputation	4	1/3	1/4	1	1/7	0.075
Salary	8	7	2	7	1	0.506

Note. This table is from Saaty, 2008, p. 88.

Table 2.10

Pairwise Comparison Matrix for Sub-criteria with Respect to Flexibility

	Location	Time	Work	Priorities
Location	1	1/3	1/6	0.091
Time	3	1	1/4	0.218
Work	6	4	1	0.691

Note. This table is from Saaty, 2008, p. 88.

Table 2.11

Pairwise Comparison Matrix for the Alternatives with Respect to Potential Increase in Salary

	Domestic Com	Int'l Com	College	State Univ.	Priorities
Domestic company	1	4	3	6	0.555
Int'l company	1/4	1	3	5	0.258
College	1/3	1/3	1	2	0.124
State University	1/6	1/5	1/2	1	0.064

Note. This table is from Saaty, 2008, p. 88; Int'l = International.

In the fourth step, local priorities of all elements need to be calculated and then global priorities are calculated. First of all, local priorities are calculated by eigenvector method (Saaty, 2000). The calculation procedures of local priorities are as follows:

1. Square the matrix.
2. Each row scores are summed and normalized by the total score.
3. Iterate this process till there is no difference between normalized scores of two contingent iterations to four decimal places.

An example calculation procedure is explained using Table 2.10. In step 1, the matrix of Table 2.10 as the input matrix is squared as follows:

$$\begin{bmatrix} 1.0000 & 0.3333 & 0.1667 \\ 3.0000 & 1.0000 & 0.2500 \\ 6.0000 & 4.0000 & 1.0000 \end{bmatrix} \times \begin{bmatrix} 1.0000 & 0.3333 & 0.1667 \\ 3.0000 & 1.0000 & 0.2500 \\ 6.0000 & 4.0000 & 1.0000 \end{bmatrix} = \begin{bmatrix} 3.0000 & 1.3333 & 0.4167 \\ 7.5000 & 3.0000 & 1.0000 \\ 24.0000 & 10.0000 & 3.0000 \end{bmatrix}$$

For example, the entry of the first row and the second column in the squared matrix is calculated as follows: (1.0000 x 0.3333) + (0.3333 x 1.0000) + (0.1667 x 4.0000) = 3. In step 2, first, scores of each row are summed as follows:

$$\begin{bmatrix} 3.0000+1.3333+0.4167 \\ 7.5000+3.0000+1.0000 \\ 24.0000+10.0000+3.0000 \end{bmatrix} = \begin{bmatrix} 4.7500 \\ 11.7500 \\ 37.0000 \end{bmatrix}$$

Second, summed scores are normalized by the total score (4.7500 + 11.7500 + 37.0000 = 53.2500) as follows:

$$\begin{bmatrix} 4.7500/53.2500 \\ 11.7500/53.2500 \\ 37.0000/53.2500 \end{bmatrix} = \begin{bmatrix} 0.0892 \\ 0.2160 \\ 0.6948 \end{bmatrix}$$

The results are the first eigenvector. This procedure must be iterated until the eigenvector solution does not change from the previous iteration. In the second iteration, the input matrix is the squared matrix of the first iteration. The eigenvector solutions of the second iteration and the difference from the previous iteration are as follows:

$$first\ iteration \begin{bmatrix} 0.0892 \\ 0.2160 \\ 0.6948 \end{bmatrix} - \sec ond\ iteration \begin{bmatrix} 0.0914 \\ 0.2176 \\ 0.6909 \end{bmatrix} = \begin{bmatrix} -0.0022 \\ -0.0017 \\ 0.0040 \end{bmatrix}$$

Because the differences between two iterations are larger than expected ones, more iteration is required. The eigenvector solutions of the third iteration and the difference from the second iteration are as follows:

$$\text{sec}ond\ iteration \begin{bmatrix} 0.0914 \\ 0.2176 \\ 0.6909 \end{bmatrix} - third\ iteration \begin{bmatrix} 0.0914 \\ 0.2176 \\ 0.6909 \end{bmatrix}$$

There is no difference between the two contingent iterations to four decimal places. No more iteration is necessary and the results are accepted as eigenvector solutions.

After local priorities are calculated, global priorities need to be calculated for sub-criteria (objective) and alternative level by multiplying each local priority by the global priority of the parent. In the criteria level, local priorities are the same as the global priorities and no calculation is required. In the sub-criteria level, a local priority of a sub-criterion is multiplied by the priority of the parent of a sub-criterion. For example, in Table 2.12, the priority of "location" (0.091) is multiplied by the priority of "flexibility" (0.036) to obtain the global priority of "location" (0.033). In the alternative level, the global priority of an alternative in term of a parent is calculated by multiplying the local priority of the alternative in terms of the parent by the global priority of the parent (sub-criterion or criterion). For each alternative, nine global priorities, one for each sub-criteria or criteria, are calculated. The overall priority of each alternative is calculated by summing up these nine global priorities. For example, in Table 2.13, the global priority (0.043) of *domestic company* in term of *potential increase in the salary* is calculated by multiplying the local priority (0.555) of *domestic company* in terms of potential increase in the salary by the global priority (0.078) of potential increase in the salary obtained in Table 2.12. Overall priority of *domestic company* (0.193) is calculated by summing up the nine priorities in a row of domestic

company in Table 2.13. Concerning how overall priorities are calculated, Saaty (2008) explained the procedure as follows:

> The overall priorities for the alternative jobs … are the sums across each row for the alternatives. Note that they sum to 1.0. These priorities may also be expressed in the ideal form by dividing each priority by the largest one, 0.333 for International Company [as given in Table 2.14]. (p. 90)

Using the priorities of four alternatives (types of job); a decision maker can make a decision on selecting best type of job after getting a Ph.D. degree.

Applications of AHP

AHP as a MCDM tool has been successfully applied to many different fields for various purposes. In a recent review study of AHP applications, Vaidya and Kumar (2006) analyzed a total of 150 application papers, which were classified into three groups: based on theme, specific applications, and combined with other methodologies. They mentioned that "Themes in the first group are selection, evaluation, benefit–cost analysis, allocations, planning and development, priority and ranking, and decision-making. … Second group consists of the specific applications in forecasting, and medicine and related fields" (p. 3). The areas of applications were "personal, social, manufacturing sector, political, engineering, education, industry, government, and others which include sports, management, etc" (p. 3).

Table 2.12

Synthesizing to Obtain Global Priorities of Elements of Criteria and Sub-Criteria Level and Local Priorities of Alternatives

		Flexibility			Future opportunity			Security	Reputation	Salary
Criteria		0.036			0.122			0.262	0.075	0.506
Sub-criteria		Location	Time	Work	Enterpr-eneurial	Salary Increase	Top Level Position			
(Local Priority)		0.091	0.218	0.691	0.105	0.637	0.258			
Global Priority (Criteria x Sub-criteria)		0.003	0.008	0.025	0.013	0.078	0.032	0.262	0.075	0.506
Local Priority of Alternative	Domestic Co	0.295	0.084	0.062	0.090	0.555	0.591	0.225	0.064	0.124
	Internatn'l Co	0.496	0.055	0.115	0.061	0.258	0.274	0.054	0.101	0.547
	College	0.131	0.285	0.249	0.239	0.124	0.083	0.095	0.247	0.289
	State Univ.	0.078	0.576	0.574	0.610	0.064	0.052	0.626	0.588	0.039

Note. This table is modified from Saaty, 2008, p. 89.

Table 2.13

Synthesizing to Obtain Global Priorities of Alternatives and Overall Priorities of Alternatives

		Flexibility			Future opportunity			Security	Reputation	Salary	
Criteria		0.036			0.122			0.262	0.075	0.506	
Sub-criteria		Location	Time	Work	Enterpr -eneurial	Salary Increase	Top Level Position				
		0.091	0.218	0.691	0.105	0.637	0.258				Overall
Global priority		0.003	0.008	0.025	0.013	0.078	0.032	0.262	0.075	0.506	priority
Global Priority of Alternative	Domestic Co	0.001	0.001	0.002	0.001	0.043	0.019	0.059	0.005	0.063	0.193
	Internatn'l Co	0.001	0.000	0.003	0.001	0.020	0.009	0.014	0.008	0.277	0.333
	College	0.000	0.002	0.006	0.003	0.010	0.003	0.025	0.019	0.146	0.214
	State Univ.	0.000	0.005	0.014	0.008	0.005	0.002	0.164	0.044	0.020	0.262

Note. This table is modified from Saaty, 2008, p. 89.

Table 2.14

Final Results Shown as Normalised Priorities and Idealised Priorities

Name	Normalized priorities	Idealized priorities
Domestic Company	0.193	0.579
Internatn'l Company	0.333	1.000
College	0.214	0.643
State University	0.262	0.785

Note. This table is from Saaty, 2008, p. 90.

AHP has been applied to a variety of marketing problems. In a review of marketing applications of AHP, Davis (2001) found that trade-off procedures are included in all applications and selection problems are related to making a best choice among many single alternatives or from combined alternatives. In terms of consumer selection decisions, applied areas were consumer choices of airlines companies (Bahmani, Javalgi & Blumburg, 1986, as cited in Davis, 2001) and finding important attributes in the process of selecting a restaurant (Armacost & Hosseini, 1994, as cited in Davis, 2001).

Concerning justification for using AHP, Davis (2001) discussed that AHP can deal with the different types of data in a variety of ways, such as the merging of intangible with tangible data for industrial purchasing decisions (Calantone et. al., 1999; Ghodsypour & O'Brien, 1998; Vargas & Saaty, 1981,), logic and feelings (Bahmani et al., 1986), or qualitative with quantitative factors (Dyer et. al., 1992; Ghodsypour &

O'Brien, 1998). In selecting walking shoes, there are differences in types of data of decision criteria (e.g., price, comfort, fit, brand, fashion, and technical features). Some are quantitative and others are qualitative. Some are subjective and others are objective. AHP can be a proper method to handle these different types of data. So far, however, AHP has not been used in the practice of selecting daily used sporting goods, such as walking shoes.

Possible Two-Stage Solutions for Selecting Walking Shoes

As mentioned above, the two-stage method can be applied to consumer decision making situations when there are a lot of alternatives and alternatives are evaluated with respect to multiple criteria. This method can be applied to selecting walking shoes.

The First Stage

The typical procedure of the first stage is to reduce the number of alternatives to a manageable level through a simplified evaluation process, in which consumers apply discriminating thresholds of one or two criteria to all available alternatives. As a result of the first stage procedure, a consumer is expected to have a consideration set which includes five pairs of walking shoes as alternatives.

It is, however, very difficult for consumers to use quality criteria (e.g., comfort or fit) as a discriminating criterion because they do not have a proper method for figuring out qualities of shoes easily. They should physically wear athletic shoes to figure out comfort and fit. It is impossible for them to wear all available shoes to select a consideration set. Therefore it is natural that a consumer should use only non-quality

criteria such as technical features, style/fashion, and price as discriminating thresholds. As a result, a consideration set includes alternatives which need to be eliminated from the consideration set in terms of the quality of the shoes.

The discrepancy can happen when a consumer uses only non-quality criteria as discriminating thresholds. This discrepancy need to be reduced because it can cause problems in later selection procedures in which a consumer makes a bad final choice or loses at least a chance to make a better choice.

The Second Stage

The typical procedure of the second stage is that a consideration set is evaluated to make the final choice considering all influencing criteria. In applying AHP to selecting walking shoes, AHP will work as a DSS by helping consumers to improve the process of making a choice of walking shoes. Using AHP, they can take care of the complicated task of “selecting walking shoes” in an easier and clearer way by putting by ordering complicated components into a hierarchy. Hierarchy is the most powerful method of classification used by the human brain in ordering complexity and the use of hierarchical ordering is a natural manner of human thought in the face of complexity (Whyte, 1969). Also AHP method helps consumers to make preference rankings for alternatives without conflicts considering the hierarchy of whole decision making process. Multiple criteria can conflict with each other in evaluating alternatives and decision makers need to have methods for resolving conflicts. There is always some form of tradeoffs between criteria when multiple criteria are considered in the evaluation process (Stewart, 1992). They have some limitations in taking care of these

conflicts (Payne et al., 1993). AHP method helps decision makers to figure out their preference without conflicts in evaluating alternatives considering all criteria together.

Personal Factors in Selecting Athletic Shoes: Age and Gender

Demand for a certain product and service is affected by age (Proctor, 1996). People buy different products and services over their lifetime and at different ages (Kotler, Swee, Siew, & Chin, 1994). Age has been found to affect the consumption pattern of products and service because of different demands (Hawkins et. al., 2001). Different age groups choose athletic shoes for different purposes. While the use of athletic shoes for casual wear and fashion plays a large role in shaping young people's appearance and features, the baby boomer population is a good potential market for athletic shoes for daily use (Pribut & Richie, 2002).

Within every society, it is quite common to find products that are either exclusively or strongly associated with the members of one gender. Gender roles have an important cultural component. It is quite fitting to examine gender as a sub-cultural category (Schiffman & Kanuk, 1997). There is some difference in the way people select athletic shoes between males and females. Females focus more on the appearance of the product such as style, design, and brand name while males tend to consider internal factors such as comfort and quality as more important factors (Solomon & Schopler, 1982; Taylor & Cosenza, 2002).

Evaluation of Two-Stage Strategy

The two-stage strategy is evaluated in each stage separately. In the evaluation of the first stage, the quality of consideration sets is examined. The evaluation of the

second stage can be conducted by the evaluation of AHP using the DSS evaluation system.

The First Stage: Consideration Set Quality

Performance of purchasing products can be measured by evaluating consideration set quality (Haubl & Trifts, 2000). Haubl and Trifts suggested that the measurement of the consideration set quality be conducted by counting the number of superior products which have higher criteria values in the consideration set. The quality of the selected athletic shoes as a consideration set can be measured by the number of good quality shoes among selected shoes as a consideration set.

The Second Stage: Evaluating AHP as DSS

The evaluation of a DSS is closely related to the needs of evaluation (Rhee & Rao, 2008). If the purpose of evaluating a DSS is to know whether users actually use it, the usability of the DSS needs to be evaluated. Or if the interest of evaluating a DSS is to comprehend whether decision makers make better decisions, the effectiveness of the DSS needs to be evaluated. Rhee and Rao (2008) explained that there are three types of evaluation methods based on the needs of evaluation:

> First, technical evaluation assesses the system's logic, algorithm, and data flow. … Second, empirical evaluation focuses on performance with the aid of DSSs. … studies have attempted to investigate the improvements in decision quality with the aid of DSSs. … Third, subjective evaluation views how effectively DSSs affect the interrelationship among the DSSs, users, organization, and environment (pp. 315-316).

In this study, AHP as a DSS is expected to help consumers make better decisions in selecting proper walking shoes. Based on the three types of evaluation methods, the experimental evaluation could be a proper method for evaluating the performance of selecting proper walking shoes with the support of AHP.

In terms of evaluating DSS, performance is the most important outcome in decision making (Lilien et al., 2004; Sharda et al., 1988). DSS is supposed to improve performance of decision making in terms of consistency. A good decision is supposed to be consistent with a decision maker's preference (Johnson & Payne, 1985; Tabatabaei, 2002). Consistency as a measure of performance represents how much decision outcomes are consistent with a decision maker's stated preferences. In previous studies (Johnson & Payne, 1985; Tabatabaei, 2002), the consistency, which was called relative accuracy, was calculated as:

$$\text{Relative accuracy} = \frac{EV_{actual\,choice} - EV_{worst\,choice}}{EV_{ideal\,choice} - EV_{worst\,choice}}, \qquad \text{Equation 1}$$

where $EV_{worst\ choice}$ is the lowest expected value and uses no information in a decision making – random selection, $EV_{actual\ choice}$ is the expected value for an actual choice and uses limited information in a decision making and EV_{ideal} is the highest expected value and uses maximum information available for making a decision. The concept of "expected value" may be explained by expected winning money in gambling, in which there is a p% chance of winning $X, the expected value is equal to pX. If there is a p% chance of X and a q% chance of Y, then EV=pX+qY. In the case of consumers' making choices, "% chance" represents the probability of selecting an alternative shoe in

terms of a given criterion and the "$X" means the importance weights of criteria. This measure of relative performance is between 1.00 for the expected value maximization strategy, and 0.0 for random selection. The relative accuracy (or consistency) indicates how close the expected value of the actual choice is to the expected value of the ideal choice (Tabatabaei, 2002).

DSS is supposed to improve performance of decision making in terms of effectiveness (Sharda et al., 1988; Todd & Benbasat, 1992). Effectiveness can be defined as a decision maker's belief about how worthwhile and productive it is to use the DSS. Effectiveness can be examined by comparing an actual and expected choice (Evans & Riha, 1989). If decision makers make the expected choice as their actual choices, the DSS works effectively (Rhee & Rao, 2008).

Satisfaction is an important outcome in the study of DSS (Lilien et al., 2004). Satisfaction of DSS users is a major criterion for evaluating the success of DSS. Satisfaction represents how much decision makers are satisfied with overall support of DSS in the decision making process. Decision makers can be asked about their satisfaction with DSS and the final decisions (Bharati & Chaudhury, 2004).

Summary of the Literature Review

Many epidemiologic studies found that walking as a moderate PA is very effective for promoting health. Walking is the most popular PA among all fitness and sports activities in the U.S. the walking shoe is the most important gear for walking. It is recommended that consumers choose walking shoes according to shoes quality, which provides comfort and fit. However, in their actual purchases, their choices are

made according to non-quality criteria such as fashion, brand, and technical features. The two major reasons that consumers have difficulties in selecting quality walking shoes are too many choices and multiple criteria such as comfort, fit, price, technical features, fashion and brand to consider when evaluating alternatives. Due to these difficulties, they make choices mostly based on non-quality criteria which are conspicuous and easy to figure out, though they try to make choices using all important criteria including the quality criteria such as comfort and fit. A two-stage decision strategy can be helpful in solving the difficulties in decision making. In the first stage, people can reduce the number of choices to a manageable level—about five alternatives —by applying one or two criteria as discriminating thresholds. In the second stage, AHP method helps people to take care of the tradeoff conflict which happens among multiple criteria in evaluating the five selected choices. If AHP can be used for selecting quality walking shoes, however, is still unknown. This study proposed an evaluation tool that consumers can use to select proper walking shoes according to their preferences.

CHAPTER 3

METHODS

The purpose of this study was to introduce AHP method that has been used to support decision making in many areas such as management, education, engineering, health, and so on. For this purpose, an actual study was designed to support consumers making decisions selecting walking shoes. For the study, 40 participants were recruited in an athletic equipment store. The participants formed the consideration set by selecting five pairs of shoes among the selection pool without putting on the shoes and then made a final choice after testing the five selected shoes. In the final decision, the participants used the two methods: making a final choice with and without the support of the AHP method. The decision making procedure was evaluated in three steps. In the first step, the quality of the consideration set was evaluated. In the second step, the effectiveness and the satisfaction of the AHP method were evaluated. In the last step, the interaction between the first step and the second step was evaluated.

Participants

The participants of this study were 40 customers recruited from an athletic equipment store in a Midwestern city. They were in two age groups (19-24 yrs. and 25-64 yrs. old) with 20 participants in each age group. The gender was balanced in both age groups, with 10 males and 10 females in each, and a total of 20 participants in each gender group. Participation in the study was voluntary. When customers came to the store to buy athletic shoes, they were asked whether they were interested in

participating in the study. They were informed about the purpose and general procedure of the study. Upon agreement to participate in the study, participants were asked to sign an informed consent form approved by the Institutional Review Board (IRB) committee of the University of Illinois at Urbana-Champaign. The permission for conducting the study in the store was acquired from the sales support manager of Dick's Sporting Goods store in Champaign, Illinois. Upon the completion of the study, each participant was given a small honorarium (i.e., $20 store gift card).

Data Collection Procedure

Major components of the data collection included: selection shoes, quality test, decision criteria to be employed, and data collection using two selection methods. These components are described below:

Selection Pool of Athletic Shoes

For each gender, a pool of 20 pairs of athletic shoes was formed for the study, including running shoes, cross-training shoes, hiking shoes, and low performance shoes (fashion athletic shoes). The selected brands included Nike, Asics, Adidas, Reebok, New Balance, Puma, DC shoes, and Merrell. Price ranges for the shoes included in the pool were wide from $39.99 to $124.99 and basically three price ranges were considered in forming the pool: low (< $50), medium ($50-$80) and high (> $80). For this study, participants were allowed select their walking shoes only from this formed pool.

Shoe Quality Test

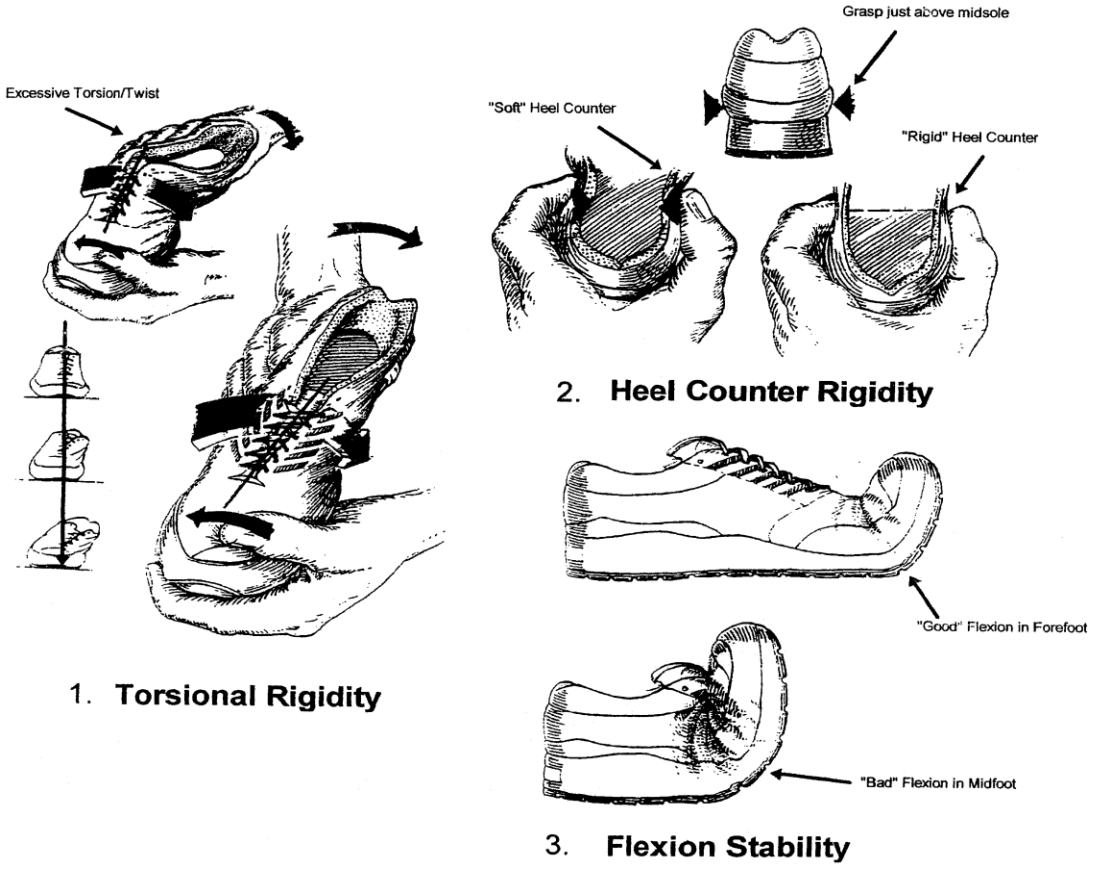
Qualities of all athletic shoes in the pool were tested using the shoe evaluation process developed by Mark Reeves, who was a DPM (Doctor of Podiatric Medicine) at Virginia Mason Seattle Main Clinic, and used by the Shoe Recommendation Committee (SRC) of the American Academy of Podiatric Sports Medicine to select quality athletic shoes. This test consists of three stability tests—flexion stability, torsional stability and heel counter stability test. Scoring system for each subtest was: 1 (*worst*), 2 (*poor*), 3, (*fair*), 4 (*good*), 5 (*excellent*). The tests were conducted by two of the athletic shoe sales assistants in the athletic equipment store. Test results were used as the quality criteria for the athletic shoes in the pool. The shoe quality test is illustrated in Figure 3.1.

Decision Criteria for Evaluating Alternatives

As described in the literature review, six attributes (i.e., comfort, fit, technical feature, fashion/style, brand and price) are often used when people select walking shoes. These attributes were also used as decision criteria for evaluating walking shoes in this study. In applying AHP, these six attributes were classified into three clusters: quality (comfort and fit), fashion (technical features and fashion/style) and others (brand and price). To be consistent with the terminology used in AHP, the three clusters are called “criteria.” Elements of each criterion (i.e., attribute) are called “sub-criteria.”

Figure 3.1

Shoes Evaluation Process



Note. This figure is adapted from American Academy of Podiatric Sports Medicine.

Overall Procedure: Two Decision-Making Methods

In previous studies (Sharda et al., 1988; Todd & Benbasat, 1992), experimental evaluations were conducted using experimental methods combined with a surveying technique (Rhee & Rao, 2008). In this study, experiments and surveys were combined to evaluate the performance of AHP as a DSS. As the experiment, two methods were compared: with and without the help of a DSS. AHP worked as a DSS and self-explication method was conducted as the method of without-a-DSS. The self-

explication method means making a choice as similar as actual selections in a store with minimum interruptions. Surveys were conducted at the end of the data collection to investigate the performance of AHP as a DSS using three evaluation factors: consistency, effectiveness, and satisfaction.

Each participant was asked to select shoes for walking using two methods: self-explication method and the AHP method. Participants selected walking shoes. Self-explication method was conducted first and followed by the AHP method. There were two stages for each method. The first stage was the same for both methods. The difference between two methods is in the second stage. Each participant did both methods. The process and characteristics of participants' decision making or preference in shoe selection were collected using three paper-and-pencil questionnaires (see Appendix A, B and C, respectively). The questionnaires were explained in the following sections of the two methods. After AHP, the collected data were coded by the researcher in Excel program developed based the scoring algorithm of AHP. Participants' preference scores and rankings of alternatives were calculated using an Excel program and then provided as recommended choices.

Self-Explication Method

The first stage. Participants were asked to select five pair of shoes from the selection pool on their own choice or preference. They decided one important attribute that they used as decision criterion in selecting the five shoes. This attribute is called discriminating attribute because people discriminate walking shoes to select the five pairs of shoes using the attribute. The data of this stage were collected using

the questions in stage 1 of the questionnaire for self-explication method (Appendix A).

The consideration set was evaluated by counting the number of good products that have higher criteria values in the consideration set (Haubl & Trifts, 2000). In this study, the quality of the selected shoes as a consideration set was measured by the number of good quality shoes within a consideration set. Good quality shoes were defined as the shoes with score “4” or “5” in the shoe quality test already conducted by the two sales clerks. Actually the average score of 3.5 or above was treated as a good quality shoe.

In selecting five pairs of shoes for formulating a consideration set, participants were supposed to make unintended choices that they should have not made if they had tried on all available alternatives. These unintended choices might cause the discrepancy between intended and actual choices, which cannot be measured directly because intended choices cannot be found without trying on all alternatives. This discrepancy happens in the quality of shoes because shoe quality cannot be found without trying them on. Therefore, the discrepancy was investigated indirectly by comparing the five shoes included in a consideration set and the three better shoes selected further from a consideration set after the shoe-test in which a participant puts on shoes and walks around the store for a while. This procedure is the comparison between before (a consideration set) and after the shoe-test (three better choices).

The second stage. A participant made best choice in this stage without the aid of DSS, such as AHP. This is a typical athletic shoe selection procedure, which occurs in

a retail athletic shoe store. Specifically, they first tried on the five pairs of shoes they selected; they then was asked to make their three better choices; finally, they made their best selection. After making best choice, they were asked to rate the importance of each of six criteria employed with respect to their making choices using a typical 5-point Likert rating scale: 1 (*unimportant*), 2 (*of little importance*), 3 (*moderately important*), 4 (*important*), 5 (*very important*). The data was collected in the second stage of the questionnaire for self-explication method (Appendix A).

AHP Method

The first stage. Since the same five pairs of shoes selected in the first stage of the self-explication method was used in AHP, the first stage of AHP was the exact same as that of the self-explication method.

The second stage. In this stage, the four-step procedure of the AHP method described in Chapter 2 was employed:

1. Define the problem and determine the kind of knowledge sought.
2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels to the lowest level (which usually is a set of the alternatives).
3. Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.
4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in

the level below add its weighed values and obtain its local or global priority. Continue this process of weighing and adding until the final priorities of the alternatives in the bottom most level are obtained.

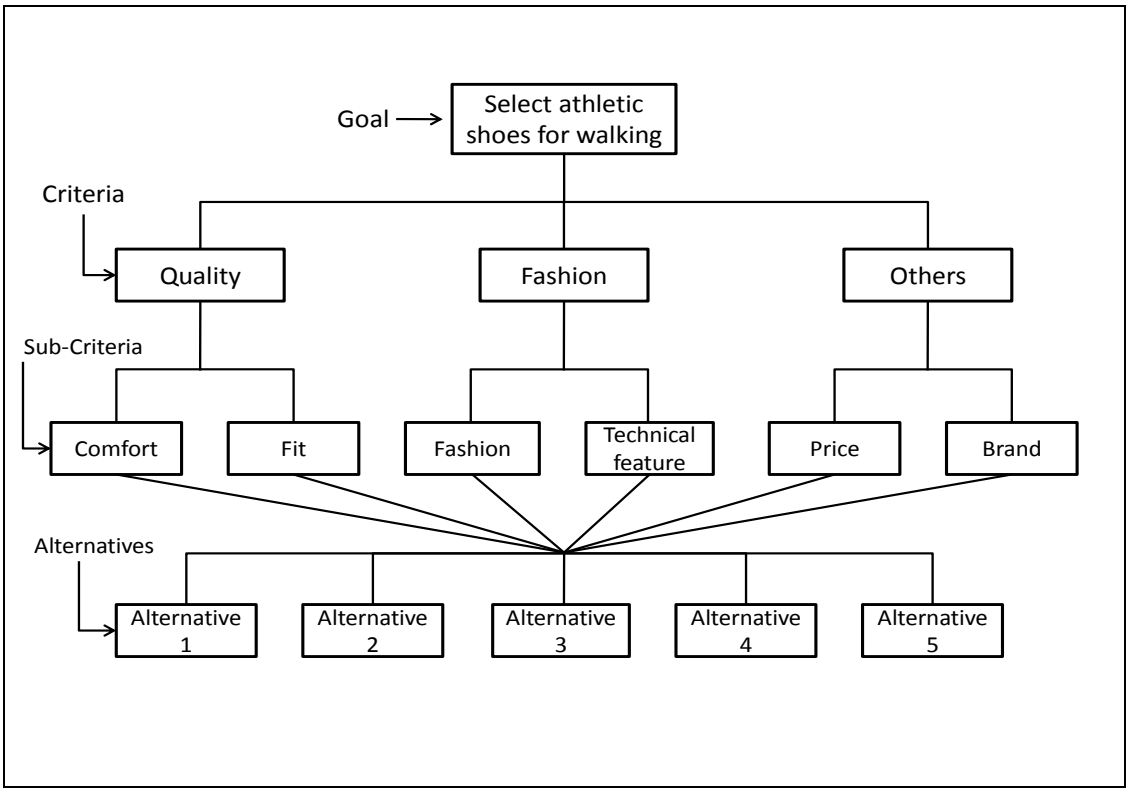
For the first step, the goal, criteria, sub-criteria and alternatives were decided as follows:

1. The goal was to select walking shoes, which are good in quality and represent consumers' preferences well.
2. The criteria used to help participants to achieve their goal were quality, fashion, and others.
3. Each criterion had two sub-criteria in a cluster: comfort and fit for quality criteria, style/fashion and technical features for fashion, and price and brand for others.
4. Alternatives were the five pairs of shoes selected in the first stage of the self-explication method.

For the second step, the hierarchy was first constructed, as illustrated in Figure 3.2. The goal of the study was located at the top level of the hierarchy. Three criteria were located at the second level. At the third level, three sets of two sub-criteria in a cluster were connected to their parent criteria, respectively. Finally, at the bottom level, each alternative (i.e., shoe) was connected to all six elements of sub-criteria.

Figure 3.2

Hierarchical Structure of Selecting Walking shoes



For the third step, sets of pairwise comparisons were constructed into matrices. The pairwise comparisons data were collected using the questionnaire for pairwise data collection (Appendix B). There were 10 pairwise comparison matrices in total. One was for the criteria with respect to the goal, shown in Table 3.1. The next three matrices were for the sub-criteria: the first one for the sub-criteria under quality: *comfort* and *fit*; the second one for the sub-criteria under fashion: *fashion* and *technical feature*; and the last one for the sub-criteria under others: *price* and *brand*. Only one out of three matrices comparing comfort and fit in terms of quality is illustrated in Table 3.2. The remaining six matrices are the comparison matrices for the

five alternatives with respect to all six sub-criteria. Only one example matrix comparing the alternatives with respect to comfort is illustrated in Table 3.3. Note that in Table 3.1, the criteria listed on the row are compared one-by-one with each criterion listed on top as to which one is more important with respect to the goal. For example, when comparing the importance of quality and fashion with respect to the goal, if quality (row) is more important than fashion (column) by the intensity 3 (see Table 2.7), write down 3 in the cell (row1, column2). If fashion (column) is more important than quality (row) by the intensity 3, write down 1/3 in the same cell. In Table 3.2, the sub-criteria on the left were compared with the sub-criteria on top as to their importance with respect to quality. For example, when comparing the importance of fit and comfort, if comfort (row) is more important than fit (column) with respect to quality by the intensity 3, write down the 3 in the cell (row2, column3). If fit (column) is more important than comfort (row) by the intensity 3, write down 1/3 in the same cell. In Table 3.3, the alternatives on the left are compared with those on top with respect to relative preference for comfort. For example, when comparing alternative 1 and alternative 2, if one prefers shoes 1 (row) to shoes 2 (column) with respect to comfort by the intensity 3, write down 3 in the cell (row2, column3). If one prefers shoes 2 (column) to shoes 1 (row) by the intensity 3, write down 1/3 in the same cell.

In the fourth step, collected data were coded into the Excel program of AHP method and priorities were calculated automatically in the Excel program. All the calculations of the overall priorities for alternatives were conducted by the Excel

program as explained using an AHP example. Overall priorities for alternatives were provided as recommendations for making a final choice.

Table 3.1

Pairwise Comparison Matrix of the Main Criteria with Respect to the Goal

	Quality	Fashion	Others	Priorities
Quality				
Fashion				
Others				

Table 3.2

Pairwise Comparison Matrix for Sub-criteria with Respect to Quality

	Comfort	Fit	Priorities
Comfort			
Fit			

Table 3.3

Pairwise Comparison Matrix for the Shoes as the Alternatives with Respect to Comfort

	Shoe 1	Shoe 2	Shoe 3	Shoe 4	Shoe 5	Priorities
Shoe 1						
Shoe 2						
Shoe 3						
Shoe 4						
Shoe 5						

Evaluation of AHP. Finally, after the completion of the AHP method, the evaluation of the AHP method was conducted using survey questions and indexes. The evaluation consists of three parts: consistency, effectiveness and satisfaction. First, the consistency was calculated by the following formula modified from Equation 1 in the literature review (Johnson & Payne, 1985; Tabatabaei, 2002):

$$\text{Decision consistency} = \frac{PS_{actualchoice} - PS_{worstchoice}}{PS_{idealchoice} - PS_{worstchoice}}, \qquad \text{Equation 2}$$

where $PS_{worst\ choice}$ is the lowest preference score calculated by AHP, $PS_{actual\ choice}$ is the preference score for the best choice that a participant makes and PS_{ideal} is the highest preference score provided by AHP. In Equation 2, the preference score (PS) calculated by AHP was used instead of the expected value (EV). $PS_{actual\ choice}$ can be the preference score for the best choice of the self-explication method. In case of selecting the three better choices among the five pairs of shoes of a consideration set, another

decision consistency was calculated using three different PS: $PS_{worst\ choice}$ is the sum of three lowest preference scores, $PS_{actual\ choice}$ is the sum of three preference scores of the three better choices that a participant made using the self-explication method, and PS_{ideal} is the sum of three highest preference scores provided by the AHP method.

Second, the effectiveness is examined by comparing an actual and expected choice (Evans & Riha, 1989). If a decision maker makes an expected choice as an actual choice, the DSS works effectively (Rhee & Rao, 2008). In selecting walking shoes, an expected choice could be a recommended choice of the AHP method and an actual choice could be the final choice that a participant wants to actually purchase. Three different cases were decided by comparing choices of self-explication and the AHP method in two steps: agreement, acceptance, and denial. In the first step, the agreement and disagreement between choices of the self-explication and the AHP method were determined, and in the second step, the acceptance and denial of an expected choice (a recommended choice of AHP) as a final choice (an actual choice) were determined further in case of the disagreement. If AHP is effective, a person should be willing to accept a recommended choice (a top-ranking shoe in a preference score) of the AHP method as a final choice. In the first question in the questionnaire for evaluating AHP method (Appendix C), participants were asked to decide whether they accept a recommended shoe of the AHP method as their final choice if the recommended choice of the AHP method was different from the best choice of the self-explicative method. The effectiveness of the AHP method was evaluated by the

agreement between the expected choice and the final choice and by the acceptance of the expected choice as the final choice.

Third, satisfaction represents to what degree decision makers are satisfied with overall support of DSS in the decision making process. Decision makers can be asked about their satisfaction with DSS and the final decisions (Bharati & Chaudhury, 2004). In responding to the second and third questions in the questionnaire for evaluating AHP method (Appendix C), participants were asked to rate their satisfaction with their final choice and the overall selection procedure including AHP.

Data Analyses

To address hypothesis tests as described in Chapter 1, three sets of analyses were conducted for first-, second-, and cross-stage, respecitvely. The first stage was about the consideration set, the second stage was about AHP, and the last stage was about the cross-stage interaction. Before describing the three analysis stages, the information on six shoe attributes are described.

Information on the Shoe Attributes

In this study, the six shoe attributes—*comfort*, *fit*, *brand*, *technical features*, *fashion*, and *price*—were used to evaluate walking shoes for the data analysis. Among the attributes, two shoe-quality attributes—comfort and fit—were used only in the analysis of the AHP method. In the analysis for the shoe selections using the self-explication method—a way of selecting athletic shoes as naturally as we buy athletic shoes in retail stores without restriction or intervention, the shoe quality, which was measured in the shoe evaluation process (refer to Figure 3.1) was used instead of

comfort and fit as a combined attribute. The quality score of each shoe was measured by two sales assistants in the athletic shoe department. The rounded average score of the two scores measured by the sales assistants was used as a measure of shoe quality. The four remaining attributes—brand, technical features, fashion, and price—could be easily detected by participants without testing shoes. Among these four attributes, three attributes—brand, technical features, and fashion—were dichotomized in the data analysis and price was used without change. Concerning brand, *Nike* and *Asics* were the two major brands in the store. These two brands were classified as major brands and other brands as non-major brands. In terms of technical features, if the shoes had one or more technical features, which are most recently developed or most advanced techniques of each athletic shoe company (i.e., Nike Shox, Asics Gel), those shoes were classified as *yes* in the technical features. Other shoes were classified as *no* in the technical features. Regarding fashion, if the shoes had recently applied fashion features in terms of color, design, and style, those shoes were classified as *yes* in the fashion features. Other shoes were classified as *no* in the fashion features. For information on the five shoe attributes such as quality, brand, technical features, fashion, and prices, refer to Table 3.4.

Table 3.4

Information on Athletic Shoes Included in the Selection Pool

Shoe Name	Gender	Type	Price	Technical Features
Nike Shox Turbo +9	M	Running	114.99	Nike Shox
Nike Air Max Moto +7	M	Running	84.98	Max Air
Nike Air Edge TR	M	Training	69.98	
Nike Air Circuit II	M	Training	79.99	Nike Air
Nike Generate MSL	M	Training	54.99	Nike Air
Asics Gel Nimbus 11	M	Running	124.99	IGS, Solyte
Asics GT 2140	M	Running	89.98	GEL, DuoMax
Asics Kanbara 4	M	Running	49.99	GEL
Asics Gel 150 TR	M	Training	49.99	GEL, DuoMax
New Balance MR769	M	Running	79.99	TS2, ABZORB
New Balance MR749ST	M	Running	69.99	ABZORB
New Balance MT479	M	Training	59.99	
Reebok To The Zone TR	M	Training	64.99	
Reebok High Heat Trainer	M	Training	54.99	HexRide
Adidas Kanadia TR 2	M	Training	69.99	adiPRENE, adiWear
Adidas No Mercy Low	M	Other	49.99	
Puma Cerea II	M	Running	77.99	Spider Cell
Puma Voltaic Ripstop	M	Running	69.99	CM-EVA midsole with visible iCell

Table 3.4 (cont.)

Shoe Name	Gender	Type	Price	Technical Features
DC shoes White	M	Other	59.99	
DC shoes White Navy	M	Other	49.99	
Nike Shox Turbo +8	F	Running	99.99	Nike Shox
Nike Air Max Moto +7	F	Running	84.98	Max Air
Nike Zoom Quick Sister	F	Training	59.99	
Nike Zoom Tr Essential II	F	Training	69.98	Nike Air
Nike Air Max Train MSL	F	Training	54.99	Max Air
Nike T Lite V	F	Training	39.98	
Asics Gel Nimbus 11	F	Running	124.99	IGS, Solyte
Asics GT 2140	F	Running	89.98	GEL, DuoMax
Asics Gel 1140	F	Running	74.98	GEL, DuoMax
Asics Gel Enduro	F	Other	49.99	GEL
Asics Gel Strike II	F	Running	39.98	GEL
New Balance 415	F	Running	59.99	
New Balance 622	F	Training	54.99	ABZORB
New Balance 654B	F	Other	49.99	ABZORB
Adidas Response Cushion	F	Running	84.99	FORMOTION, adiPRENE, TORSION
Adidas Supernova Glide	F	Running	79.99	FORMOTION, adiPRENE, TORSION
Adidas Allegra	F	Running	49.99	adiPRENE, TORSION
Adidas Split Step Edge	F	Training	39.99	
Merrell Siren Ventilator	F	Other	89.99	Vibram Siren Sole, Q-Form

Table 3.4 (cont.)

Shoe Name	Gender	Type	Price	Technical Features
Merrell Siren Song	F	Other	79.99	Vibram Siren Sole

Analysis for the First Stage

For the first stage, statistical analyses were performed to examine the consideration set in three sections. In the first section, the discriminating criterion—the most important shoe attribute in selecting shoes for forming a consideration set—and the perceived importance of six shoe attributes were examined using descriptive statistics. In the second section, the quality of the selected shoes as the consideration set was investigated. In the last section, the inferential analysis was implemented to examine which shoe attributes—brand, technical features, fashion and price—were important in selecting five alternatives from the selection pool of the twenty shoes to form a consideration set.

The First Section of the First Stage

In descriptive analysis, the discriminating criterion and the perceived importance of the six shoe attributes were investigated using frequency tables. In this section, only a descriptive analysis was conducted.

The Second Section of the First Stage

In descriptive analysis, the number of quality shoes within a consideration set was investigated using frequency analysis. In the inferential analysis, the number of quality shoes within a consideration set was investigated using ANOVA. The

independent variables were gender and age (two categories: 19-24 yrs. and 25-64 yrs.). The differences in the number of quality shoes between the two genders and between the two age groups were evaluated. The interaction between gender and age was tested.The inferential tests for skewness and kurtosis (Cramer, 1997) were conducted to test the normality of the dependent variable that ranges only between one and five, which has a high possibility of violating the assumption of the normal distribution.

The Third Section of the First Stage

The third section of the data analysis was to examine how participants select shoes in the self-explicate method without the support of the AHP method. The shoe selection procedure for the self-explicate method consists of two steps. In the first step, five shoes were selected from the selection pool to form a consideration set without the shoe-test. In the second step, three better shoes were selected from a consideration set after the shoe-test, and then best shoe was selected from three better shoes.

Two separate analyses were conducted for the two steps. For the first step, the selection pool was grouped into the two sets of shoes: a consideration and non-consideration set. Descriptive analyses were conducted using contingency tables to investigate how the shoe attributes—each attribute separately—were distributed in the two groups of shoes. The inferential analysis was implemented to evaluate how two groups of shoes are selected by each participant using Generalized Estimating Equations (GEE; Liang & Zeger, 1986; Hardin & Hibe, 2003), which is an extension of General Linear Model (GLM) to grouped or repeated (or longitudinal) data analysis.

GEE can accounts for a correlation matrix for grouped (or repeated) observations from each subject. In the model for the first step, *binary logistic* (a link function) was selected as a types of model, and unstructured *matrix* was chosen as a working correlation matrix. The dependent variable was two categories—expected to be correlated, and the predictor variables were the four shoe attributes such as brand, technical features, fashion, and price. Among the six shoe attributes, the two quality-related attributes (comfort and fit) was not included in the model because those attributes cannot be detected without the shoe-test.

For the second step, a consideration set was grouped into the three shoe sets: selected as a consideration set but not selected as three better shoes, selected as three better shoes but not selected as best shoe, selected as best shoe. The similar analyses were conducted as conducted for the first step. The inferential analysis was conducted to evaluate the prediction of selecting the three groups (ordered according to preference) using GEE, In the model for three grouped shoe data, *ordinal logistic* (a link function) was used as a types of model, and *unstructured matrix* as a working correlation matrix. The dependent variable was three ordered groups—expected to be correlated, and the predictor variables were the five shoe attributes such as quality, brand, technical features, fashion, and price. Among six shoe attributes, the two quality-related attributes (comfort and fit) were measured with shoe-quality measured using the shoe-quality test.

Analysis for the Second Stage

For the second stage, data analysis was conducted to evaluate AHP in three parts: the consistency of preference, the effectiveness of AHP, and the satisfaction of AHP. AHP was compared to the self-explication method.

Consistency of Preference

The consistency index, which represents the consistency in shoe selections between the self-explication and the AHP method, was calculated using Equation 2 on Page 95 in two different ways: one for best choice and the other for three better choices. The effects of gender and age on the consistency were evaluated. The hypotheses were tested using ANOVA with gender and age as independent variables and the consistency index as a dependent variable.

Effectiveness of AHP

The effectiveness of AHP was evaluated by checking whether participants selected a recommended choice of AHP as their final choice. Two indexes—the agreement and acceptance rate—were calculated to evaluate the effectiveness of AHP. The agreement rate was calculated first, and then the acceptance rate was calculated. The agreement rate was calculated using the following formula:

Agreement rate = number of agreement cases / total number of cases,

Equation 3

where agreement means that the best choice was made by the self-explication method and the best choice recommended by AHP are the same. The acceptance rate was calculated using the following formula:

Acceptance rate = number of acceptance cases/ (total number of cases – the number of agreements), Equation 4

where acceptance means that a participant accepts the best choice recommended by AHP as the final choice when the best choice of the AHP method and of the self-explication method were different.

Acceptance was divided into three categories: *agree*, *accept, or deny*. The dividing procedure had two steps. First, *agree* or *disagree* between the best choices of self-explication and of the AHP method was decided. In the next step, the *disagree* category was divided into two categories: *accept* or *deny* of the recommended choice of AHP as the final choice.

The associations of effectiveness (the three acceptance categories) with gender and age were investigated by Chi-square tests. Fisher's exact tests were also conducted when frequencies of some cells were less than five.

Satisfaction of AHP

The satisfaction of AHP was defined in two ways: first, the satisfaction of the whole selection procedure, including AHP, and second, the satisfaction of the final choice that a participant makes after comparing the best choice of the self-explicate method and the recommended choice of the AHP method. The satisfaction levels were measured using a 5-point Likert scale: 1 (*unsatisfied*), 2 (*a little satisfied*), 3 (*moderately satisfied*), 4 (*satisfied*), 5 (*very satisfied*). The satisfaction levels on the selection procedure and on the final choice were represented in frequency tables as descriptive statistics. The associations of the satisfactions by gender and by age were

investigated, and the associations of the satisfactions with the consistency and with the effectiveness were evaluated.

Chi-square tests were conducted to evaluate the associations of the satisfaction levels with gender and age. Fisher's exact tests were conducted additionally when frequencies of some cells were less than five. Correlation analyses were conducted to test associations between the satisfaction levels and the consistency index. The measures of associations were evaluated with a nonparametric correlation measure—Spearman's *rho*—because the satisfaction level was ordinal variable. Chi-square tests were implemented to examine the association between the satisfaction levels and the acceptance. Fisher's exact tests were conducted additionally when frequencies of some cells were less than five.

Across Two Stages

Finally, in the cross-stage analyses, the association between the first stage analysis and the second stage analysis was examined in three ways: the associations between the number of quality shoes within a consideration set and the three different measures calculated in the second stage—the consistency index, the acceptance, and the satisfaction to AHP. First, the relationship between the number of quality shoes in a consideration set and the consistency index was evaluated using a correlation analysis. The measures of associations were evaluated using Spearman's *rho* because the distributions of the both variables did not follow normal distributions. Next, the relationship between the number of quality shoes and the acceptance was represented descriptively in a two-way contingency table. The association between

those two variables was evaluated using a Chi-square test. Fisher's exact tests were conducted additionally, if necessary. Finally, the association between the number of quality shoes and the two satisfaction levels—the satisfaction levels for overall AHP selection procedure and for the final choice—were represented descriptively in two different two-way contingency tables. The associations were tested using Chi-square tests. Fisher's exact tests were conducted if necessary.

All statistical analyses were conducted using SPSS 17.0, a statistical analysis software, with $\alpha = .05$. When there is a need, experiment-wise error rates were controlled by the Bonferroni technique.

CHAPTER 4

RESULTS

Since three sets of analyses were conducted by stage, the results of the analyses were also presented and described according by stage. For each stage, descriptive analysis results were reported first, followed by the hypothesis-testing results.

Results of the First Stage

In the first stage, the analyses results were provided in three sections. The first section provided only descriptive analysis results on shoes and shoe attributes. In the second section, the number of quality shoes in a consideration set was investigated using ANOVA. The last section consisted of three subsections for analyzing the selection of three different sets of shoes: five choices as a consideration set, three better choices, and best choice.

The First Section of the First Stage

To describe shoes and shoe attributes for this study, three analysis results were provided: all the shoes in the selection pool, the discriminating criterion, and the importance of six shoe attributes. First, twenty shoes were selected for each gender to form the selection pool from which participants selected shoes to form a consideration set. The number of shoes by levels of each shoe attribute was provided in Table 4.1. There was no major difference between male and female shoes in the number of shoes by shoe attributes except for small differences in *price* and *quality* between male and female shoes. The number of shoes was balanced across levels of each

attribute. Next, the frequency of the discriminating criterion—the most important shoe attribute in selecting shoes for forming a consideration set, by gender and age, was provided in Table 4.2. Twenty-six out of forty participants (65%) selected *comfort* as their discriminating criterion. *Comfort* was clearly the most important shoe attribute in forming a consideration set. On the contrary, no one chose *technical features* as the discriminating criterion. In terms of fashion, some difference was found between genders. Six female participants (30%) selected *fashion* as their discriminating criterion. No male participant selected *fashion* as their discriminating criterion. No conspicuous differences in the shoe attributes were found between the two age groups. Finally, the frequency analysis for the importance of the six shoe attributes by gender and age was represented in Table 4.3. The importance of a shoe attribute was scored between 1 (*unimportant*) and 5 (*very important*). Most participants thought of *comfort* and *fit* as an "*important"* or "*very important"* attribute. On the contrary, most of them did not regard *technical features* or *brand* as an *important* or *very important* attribute. Some associations were found in the four combinations: comfort by gender, fashion by age, brand by age and price by gender.

Table 4.1

Frequency of Shoe Attributes

		Male Shoes	Female Shoes
Quality (score)	< 3.0	3 (15%)	8 (40%)
	3.0 - 3.9	10 (50%)	4 (20%)
	4.0 - 4.9	5 (25%)	7 (35%)
	5.0	2 (10%)	1 (5%)
Price ($)	< 50.00	4 (40%)	6 (30%)
	50.00 - 59.99	4 (20%)	4 (20%)
	60.00 - 69.99	5 (25%)	1 (5%)
	70.00 - 79.99	3 (15%)	3 (15%)
	80.00 - 89.99	2 (10%)	4 (20%)
	90.00+	2 (10%)	2 (10%)
Brand	Non-major brand	11 (55%)	9 (45%)
	Major brand	9 (45%)	11 (55%)
Technical	No	10 (50%)	10 (50%)
Features	Yes	10 (50%)	10 (50%)
Fashion	No	10 (50%)	10 (50%)
	Yes	10 (50%)	10 (50%)

Table 4.2

Frequency of Discriminating Criteria

Gender	Age	Attributes						
		Comfort	Fit	Technical features	Fashion	Brand	Price	Total
Male	19-24 yrs	6	1	0	1	2	0	10
	25-64 yrs	9	1	0	0	0	0	10
	Total	15	2	0	1	2	0	20
Female	19-24 yrs	6	1	0	3	0	0	10
	25-64 yrs	5	1	0	3	0	1	10
	Total	11	2	0	6	0	1	20
Total	19-24 yrs	12	2	0	4	2	0	20
	25-64 yrs	14	2	0	3	0	1	20
	Total	26	4	0	7	2	1	40

Table 4.3

Importance of Attributes

Attribute	Importance	Gender		Age		Total
		Male	Female	19-24 yrs	25-64 yrs	
Comfort	Unimportant	0	0	0	0	0
	Of little importance	0	1	1	0	1
	Moderately important	1	1	1	1	2
	Important	0	6	4	2	6
	Very important	19	12	14	17	31
Fit	Unimportant	0	1	1	0	1
	Of little importance	1	0	1	0	1
	Moderately important	1	0	1	0	1
	Important	8	7	6	9	15
	Very important	10	12	11	11	22
Technical	Unimportant	0	0	0	0	0
Features	Of little importance	8	5	4	9	13
	Moderately important	9	9	12	6	18
	Important	1	4	3	2	5
	Very important	2	2	1	3	4

Table 4.3 (cont.)

Attribute	Importance	Gender		Age		Total
		Male	Female	19-24 yrs	25-64 yrs	
Fashion	Unimportant	1	0	1	0	1
	Of little importance	5	4	3	6	9
	Moderately important	5	7	3	9	12
	Important	6	5	9	2	11
	Very important	3	4	4	3	7
Brand	Unimportant	3	4	6	1	7
	Of little importance	7	6	7	6	13
	Moderately important	4	7	2	9	11
	Important	5	2	3	4	7
	Very important	1	1	2	0	2
Price	Unimportant	0	1	1	0	1
	Of little importance	6	0	2	4	6
	Moderately important	8	8	11	5	16
	Important	2	7	3	6	9
	Very important	4	4	3	5	8

The Second Section of the First Stage

The analyses were conducted to evaluate a consideration set in descriptive statistics and hypothesis tests. The analysis results of the descriptive and inferential

statistics were presented in Table 4.4. The descriptive statistics of the number of quality shoes were calculated by gender and age. Some differences were detected between the two gender and two age groups. The male and younger age group (18≤age< 25) selected a little more quality shoes than the female and the older age group (25-64 yrs). The number of quality shoes within a consideration set was investigated using ANOVA by gender and age, including their interaction. The Levene's test of equality of error variance showed that the error variance of the dependent variable was equal across groups. The test statistics (i.e., sample skewness /standard error of skewness for skewness; sample kurtosis / standard error of kurtosis for kurtosis) for the two gender subgroups and the two age subgroups were within critical value (±2). The normality assumption for the number of quality shoes within a consideration set was not violated. The overall results of the ANOVA test showed that there were no differences between gender and age subgroups, but their interaction was statistically significant. In Figure 4.1, the graphical analysis provided a further explanation on the interaction effect. In the male group, the older age group selected more quality shoes than the younger age group; in the female group, the younger age group selected more quality shoes than the older age group.

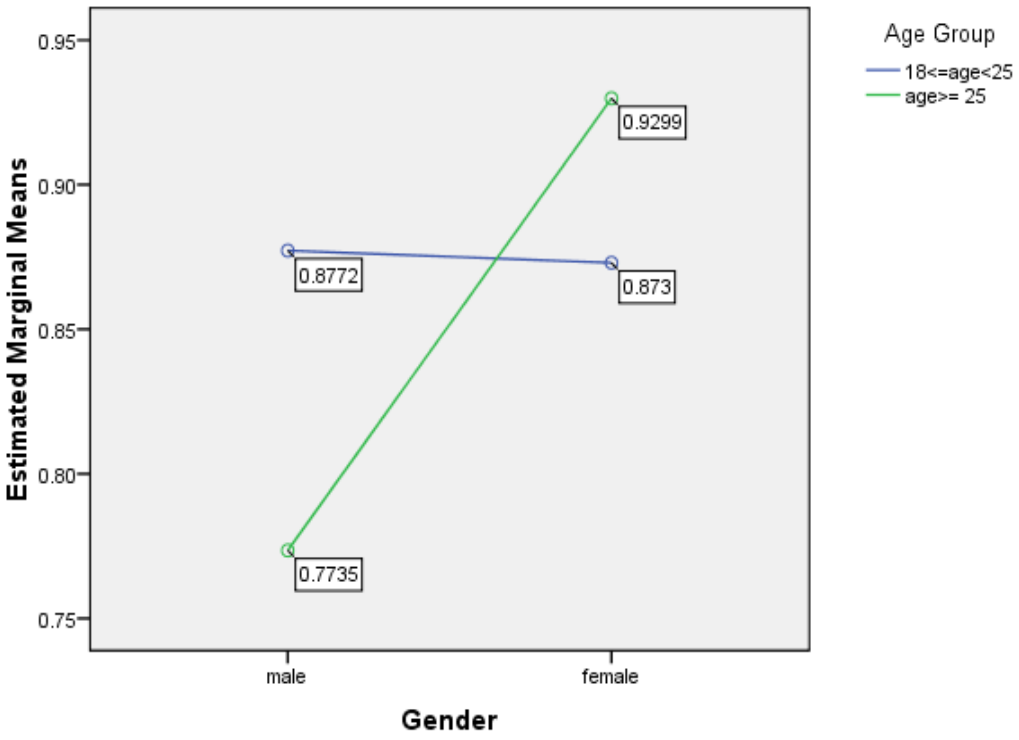
Table 4.4

The Number of Quality Shoes within Consideration Set

Gender	Age Group	*M*	*SD*	*n*
Male	19-24 yrs	3.10	0.738	10
	25-64 yrs	3.60	0.843	10
	Total	3.35	0.813	20
Female	19-24 yrs	3.70	1.252	10
	25-64 yrs	2.40	1.265	10
	Total	3.05	1.395	20
Total	19-24 yrs	3.40	1.046	20
	25-64 yrs	3.00	1.214	20
	Total	3.20	1.137	40

Figure 4.1

Estimated Marginal Means of Number of Quality Shoes within Consideration Set



The Third Section of the First Stage

In this section, data analysis was conducted to examine how participants selected shoes in the self-explicate method without the support of AHP method before and after the shoe-test. The shoe selection procedure for the self-explicate method consisted of two steps. In the first step, five shoes were selected from the selection pool to form a consideration set without the shoe-test. In the second step, three better shoes were selected from a consideration set after the shoe-test, and

then best shoe was selected from the three better shoes. These two steps were compared to check the difference in shoe choices between before and after the shoe-test. The analysis results for the two selection steps were presented in the following four tables: Table 4.5 to 4.8.

In Table 4.5 and 4.6, shoe selections were descriptively represented by shoe attributes. The descriptive analysis for the first step showed that the shoe selections to form the consideration set were related to two shoe attributes: *brand* and *technical feature*. In the descriptive analysis for the second step, further shoe selections after forming the consideration set were related to brand, technical feature, and the newly added shoe attribute for the second step—*quality*. Inferential analysis results were presented in Table 4.7 and 4.8. In the GEE model for the first step, brand and technical feature were significant predictors. For the second step, quality and technical feature were significant shoe attributes in predicting shoe selections. Brand was close to the significance level (p = .069). In both of GEE models for the first and second step, *unstructured correlation* was selected as the correlation structure for grouped shoe selections of each participant because any correlation structures were specified for both models.

Table 4.5

Contingency Tables and Descriptive Statistics of the First Step

			Shoe Choices of the Frist Step		
			Choice1	Choice 2	Total
Brand	Nonmajor brand	Count	327	73	400
		Rowwise %	81.8	18.3	100.0
	Major brand	Count	273	127	400
		Rowwise %	68.3	31.8	100.0
Technical Feature	No	Count	328	72	400
		Rowwise %	82.0	18.0	100.0
	Yes	Count	272	128	400
		Rowwise %	68.0	32.0	100.0
Fashion	No	Count	317	83	400
		Rowwise %	79.3	20.8	100.0
	Yes	Count	283	117	400
		Rowwise %	70.8	29.3	100.0
Total		Count	600	200	800
		Rowwise %	75.0	25.0	100.0
Price ($)	*M*		68.04	76.63	70.19
	SD		20.33	22.94	21.32

Note. “Choice 1” represents “not selected as a consideration set ” and “Choice 2” “selected as a consideration set.”

Table 4.6

Contingency Tables and Descriptive Statistics of the Second Steps

			Shoe Choices of the Second Step			
			Choice 1	Choice 2	Choice 3	Total
Brand	Nonmajor Brand	Count	38	23	11	72
		Rowwise %	52.8%	31.9%	15.3%	100.0%
	Major Brand	Count	42	57	29	128
		Rowwise %	32.8%	44.5%	22.7%	100.0%
Technical Feature	No	Count	32	32	9	73
		Rowwise %	43.8%	43.8%	12.3%	100.0%
	Yes	Count	48	48	31	127
		Rowwise %	37.8%	37.8%	24.4%	100.0%
Fashion	No	Count	37	34	12	83
		Rowwise %	44.6%	41.0%	14.5%	100.0%
	Yes	Count	43	46	28	117
		Rowwise %	36.8%	39.3%	23.9%	100.0%

Table 4.6 (cont.)

			Shoe Choices of the Second Step			
			Choice 1	Choice 2	Choice 3	Total
Quality	2	Count	22	6	5	33
(score)		Rowwise %	66.7	18.2	15.2	100.0
	3	Count	14	18	8	40
		Rowwise %	35.0	45.0	20.0	100.0
	4	Count	20	28	12	60
		Rowwise %	33.3	46.7	20.0	100.0
	5	Count	24	28	15	67
		Rowwise %	35.8	41.8	22.4	100.0
Total		Count	80	80	40	200
		Rowwise %	40.0	40.0	20.0	100.0
Price ($)		*M*	71.60	78.22	83.49	76.63
		SD	22.62	22.27	23.21	22.94

Note 1. "Choice 1" represents "selected as a consideration set but not selected as three better choices."

Note 2. "Choice 2" represents "selected as three better choices but not selected as best choice."

Note 3. "Choice 3" represents "selected as best choice."

Table 4.7

Test of Model Effect for the First Step

Source	Wald Chi-Square	*df*	*p*
Brand	21.809	1	.000
Technical Feature	8.359	1	.004
Fashion	2.212	1	.137
Price	2.985	1	.084

Table 4.8

Test of Model Effect for the Second Step

Source	Wald Chi-Square	*df*	*p*
Brand	3.313	1	.069
Technical Feature	7.414	1	.006
Fashion	2.178	1	.140
Quality	18.710	3	.000
Price	0.589	1	.443

Results of the Second Stage

In the second stage, the data analyses were conducted in three sections: the consistency of preference, the effectiveness of the AHP method, and the satisfaction with the AHP method. The analysis results were represented in those three sections.

Consistency of Preference

The consistency index between the self-explication and AHP method was calculated for two different purposes: selecting the most preferred shoe (best choice) and selecting the three preferred shoes (three better choices) before making the final choice for actual purchase. The analysis results were presented in Tables 4.8-4.11. For each purpose separately, the consistency index was summarized by gender and age using descriptive statistics. The hypothesis tests were conducted using ANOVA.

In the consistency index for the most preferred shoe, some statistically significant differences between the subgroups of gender and age (see Table 4.9). A large mean difference was detected between the two genders (M = 0.825, SD = 0.282 for male; M = 0.901, SD = 0.212 for female), but the standard deviation was two times larger than the mean difference. Specifically, a large mean difference (M = 0.774, SD = 0.324 for male; M = 0.930, SD = 0.119 for female) in the older group (age 25 or older) between the two genders was found, but the standard deviation was large. The ANOVA results reflected the results of the descriptive statistics (see Table 4.10). No mean difference was found between gender and age subgroups; nor their interaction effect. The Levene's test of equality of error variance showed that the error variance of the dependent variables was equal across the subgroups.

Table 4.9

Consistency Index by Gender and Age for Best Choice

Gender	Age	*M*	*SD*	*n*
Male	19-24 yrs	0.877	0.237	10
	25-64 yrs	0.774	0.324	10
	Total	0.825	0.282	20
Female	19-24 yrs	0.873	0.281	10
	25-64 yrs	0.930	0.119	10
	Total	0.901	0.212	20
Total	19-24 yrs	0.875	0.253	20
	25-64 yrs	0.852	0.251	20
	Total	0.863	0.249	40

Table 4.10

ANOVA Table for Consistency Index for Best Choice

Source	Sum of Squares	*df*	Mean Square	F	*p*
Intercept	29.819	1	29.819	468.142	<.001
Gender	0.058	1	0.058	0.908	.347
Age	0.005	1	0.005	0.086	.771
Gender × Age	0.064	1	0.064	1.012	.321
Error	2.293	36	0.064		
Total	32.239	40			

In the consistency index for three better choices (see Table 4.11), much smaller mean differences were found between gender and age subgroups than the mean differences found in the consistency index for best choice because the standard deviation (*SD* = 0.112) was much smaller than that of the consistency index for best choice (*SD* = 0.249). The results of ANOVA (see Table 4.12) showed that no mean difference was found between gender and age subgroups; nor their interaction effect. No statistical significance was found in the Levene's test of equality of error variance, either.

Table 4.11

Consistency Index by Gender and Age for Three Better Choices

Gender	Age	*M*	*SD*	*n*
Male	19-24 yrs	0.968	0.048	10
	25-64 yrs	0.950	0.072	10
	Total	0.959	0.060	20
Female	19-24 yrs	0.888	0.197	10
	25-64 yrs	0.962	0.057	10
	Total	0.925	0.146	20
Total	19-24 yrs	0.928	0.146	20
	25-64 yrs	0.956	0.063	20
	Total	0.942	0.112	40

Table 4.12

ANOVA Table for Consistency Index for Three Better Choices

Source	Sum of Squares	*df*	Mean Square	F	*p*
Intercept	35.517	1	35.517	2867.077	.000
Gender	0.012	1	0.012	0.943	.338
Age	0.008	1	0.008	0.642	.428
Gender × Age	0.021	1	0.021	1.710	.199
Error	0.446	36	0.012		
Total	36.004	40			

Effectiveness of AHP

Two statistics—agreement and acceptance rate—were calculated to investigate the effectiveness of AHP. The agreement and acceptance rate were calculated by gender and age. For all participants, the agreement and acceptance rates were .625 (62.5%) and .667 (66.7%), respectively. For male, the two indexes were .550 and .778, respectively; for female, the two indexes were .700 and .500. For the younger age group, the agreement rate was .650 and the acceptance rate was .857. For the older age group, the two rates were .600 and .500, respectively. The associations of the acceptance with gender and age were investigated using Chi-square tests. The results of the descriptive and inferential analysis were represented in Table 4.13 and 4.14. No association between acceptance and age was found according to the

Chi-square and Fisher's exact tests. The same results were found in the association between acceptance and gender.

Table 4.13

Contingency Tables for Acceptance by Age and Gender

		Age		Gender		Total
		19-24 yrs	25-64 yrs	Male	Female	
Acceptance	Deny	1	4	2	3	5
	Accept	6	4	7	3	10
	Agree	13	12	11	14	25
Total		20	20	20	20	40

Table 4.14

Chi-square Test for Acceptance and Age and Gender

	Age			Gender		
	Value	*df*	*p*	Value	*df*	*p*
Chi-Square	2.240	2	.326	2.160	2	.340
Fisher's Exact Test	2.112		.434	2.153		.355

Satisfaction of AHP

The satisfaction of AHP was examined by the satisfaction level on the overall AHP selection procedure and on the final choice. The results of the analyses were

presented in Table 4.15-4.18. The descriptive statistics of satisfaction levels were calculated by gender and age, and acceptance.

Concerning the satisfaction of the selection procedure, 57.5% of all participants reported *very satisfied,* and 35% and 7.5% of them reported *satisfied* and *moderately satisfied* (see Table 4.15). Between age subgroups, the satisfaction level (55% for *very satisfied* and 45% for *satisfied*) of the younger age group was similar to that (60% for *very satisfied*, 25% for *satisfied*, and 15% for *moderate satisfied*) of the older age group. Between gender subgroups, the satisfaction level (75% for *very satisfied* and 25% for *satisfied*) of male participants was higher than that (40% for *very satisfied*, 45% for *satisfied*, and 15% for *moderate satisfied*) of female participants. Among the three categories of acceptance, the satisfaction level (over 64% for *very satisfied* and 24% for *satisfied*) of the *agree* category was a little higher than those (50% each for *very satisfied* and for *satisfied*) of the other two categories. Chi-square tests were conducted to test the association of the satisfaction levels with gender and age. It was found that only gender was significantly associated with the satisfaction of the selection procedure according to Chi-square and Fisher's exact tests (Table 4.16).

Table 4.15

Contingency Table between Satisfaction to Selection Procedure and Age, Gender, and Acceptance

		Age		Gender		Acceptance			Total
		19-24 yrs	25-64 yrs	Male	Female	Deny	Accept	Agree	
Satisfaction	3	0	3	0	3	1	0	2	3
to Selection	4	9	5	5	9	2	5	7	14
Procedure	5	11	12	15	8	2	5	16	23
Total		20	20	20	20	5	10	25	40

Note. Satisfaction level 3, 4, and 5 represent *moderately satisfied*, *satisfied*, *very satisfied.*

Table 4.16

Chi-square Test for Evaluating the Association of Satisfaction of Selection Procedure and Age, Gender, and Acceptance

	Age			Gender			Acceptance		
	Value	*df*	*p*	Value	*df*	*p*	Value	*df*	*p*
Chi-Square	4.186	2	.123	6.273	2	.043	3.376	4	.497
Fisher's Exact Test	3.773		.185	5.802		.037	3.525		.449

In terms of the satisfaction of the final choice (see Table 4.17), 70% of all participants answered *very satisfied* and 20% and 10% answered *satisfied* or

moderately satisfied. Between the two age subgroups, the satisfaction level (80% for *very satisfied*, 15% for *satisfied*, and 5% for *moderately satisfied*) of the younger age group was higher than that (60% for *very satisfied*, 25% for *satisfied*, and 15% for *moderately satisfied*) of the older age group. Between the two gender subgroups, the satisfaction level (80% for *very satisfied*, 5% for *satisfied*, and 15% for *moderately satisfied*) of female participants was higher than that (60% for *very satisfied*) of male participants. Among the three categories of the acceptance, the satisfaction level (20% for *very satisfied*) of the *deny* category was much lower than that (about 80% for *very satisfied*) of the *accept* or *agree* categories. No difference in the frequency of the satisfaction level was found between the *accept* and *agree* categories. Chi-square and Fisher's exact tests were conducted to test the associations of the satisfaction to the final choice by gender and age (see Table 4.18), and only gender was associated with the satisfaction levels. The same result was found using Fisher's exact test. For further analyses, the relationships of "the satisfaction of AHP" with the consistency and acceptance were examined. Correlation analyses were conducted to test the associations between the satisfaction level and the consistency index. The correlation coefficients (Spearman's *rho*) between the satisfaction to the final choice and the two consistency indices (r=.301 for three better choices and r=.206 for best choice) were higher than those between the satisfaction of the selection procedure and the two consistency indices (r=.046 for three better choices and r=-.032 for best choice). None of those correlation coefficients were statistically significant. Chi-square tests were implemented to examine the association between the satisfaction level and the

acceptance. Exact tests were also conducted. The relationship of the acceptance with the satisfaction of the final choice was statistically significant, but not with the satisfaction of the selection procedure.

Table 4.17

Contingency Table between Satisfaction of Final Choice and Age, Gender, and Acceptance

		Age		Gender		Acceptance			Total
		19-24 yrs	25-64 yrs	Male	Female	Deny	Accept	Agree	
Satisfaction	3	1	3	3	1	2	1	1	4
to Final	4	3	5	1	7	2	1	5	8
Choice	5	16	12	16	12	1	8	19	28
Total		20	20	20	20	5	10	25	40

Note. Satisfaction level 3, 4, and 5 represent *moderately satisfied*, *satisfied*, *very satisfied*.

Table 4.18

Chi-squares Test for Evaluating the Association of Satisfaction of Final Choice and Age, Gender, and Acceptance

	Age			Gender			Acceptance		
	Value	*df*	*p*	Value	*df*	*p*	Value	*df*	*p*
Chi-Square	2.071	2	.355	6.071	2	.048	8.957	4	.062
Fisher's Exact Test	2.002		.413	5.894		.034	8.044		.048

Result of Across Two Stages

In this stage, the association between the first-stage analysis and the second-stage analysis was examined in three ways: the associations between the number of quality shoes within a consideration set and three different measures calculated in the second stage—the consistency index, the acceptance, and the satisfaction level of AHP.

Descriptive statistics of the consistency indexes were calculated by the number of quality shoes (see Table 4.19). For the consistency index of three better choices, no specific pattern was detected across the number of quality shoes within a consideration set except that the higher the number of quality shoes, the larger the standard deviation. For the consistency index of best choice, an interesting finding was that the higher the number of quality shoes, the lower the mean of the consistency index. The relationship between the number of quality shoes in a consideration set and the consistency index was evaluated using Spearman's *rho* correlation coefficient. The correlation coefficients were -.185 ($p > .05$) for the consistency index of three preferred choice and -.356 ($p < .05$) for the consistency index of best choice (see Table 4.20). The two variables were negatively associated though the strength of the association was not high.

Table 4.19

Descriptive Statistics between Number of Quality Shoes and Consistency Indexes

Number of Quality Shoes	Consistency Index for Three Better Choices		Consistency Index for Best Choice		n
	M	*SD*	*M*	*SD*	
0	0.886	.	1.000	.	1
1	0.954	0.065	1.000	0.000	2
2	0.995	0.013	0.949	0.126	6
3	0.946	0.070	0.955	0.093	14
4	0.946	0.119	0.715	0.317	13
5	0.845	0.253	0.796	0.409	4
Total	0.942	0.112	0.863	0.249	40

Table 4.20

Tests of Association between Number of Quality Shoes and Consistency Indexes

	Number of Quality Shoes		Number of Quality Shoes	
	Pearson *r*	*p*	Spearman's *rho*	*p*
Consistency for Three Better Choices	-.185	.253	-.032	.844
Consistency for Best Choice	-.356	.024	-.344	.030

Descriptive statistics of the number of quality shoes were represented by the acceptance and by the two satisfaction levels in Tables 4.21 and 4.22. Among the three categories of the acceptance, the mean of the number of quality shoes was lowest in the *agree* category. Across the satisfaction levels on the final choice, no specific pattern was found in the mean of the number of quality shoes. In terms of the satisfaction of the selection procedure, the higher the satisfaction levels, the larger the mean of the number of quality shoes. The mean differences between the satisfaction levels were large, but standard deviations were also very large. The results of the Chi-square tests were presented in Table 4.23. No statistically significant result was found in the association of the number of quality shoes with the acceptance and with the satisfaction of the final choice and to the selection procedure. The association between the number of quality shoes and the satisfaction of the selection procedure, which was found in the descriptive analysis, was not statistically significant (p = .079)

Table 4.21

Contingency Table between Number of Quality Shoes and Acceptance and Two Satisfaction Levels

		Acceptance			Satisfaction of Final Choice			Satisfaction of Selection Procedure			Total
		Deny	Agree	Accept	3	4	5	3	4	5	
Number	0	0	1	0	0	1	0	1	0	0	1
of	1	0	2	0	0	0	2	0	1	1	2
Quality	2	1	4	1	0	2	4	0	2	4	6
Shoes	3	1	10	3	2	4	8	2	6	6	14
	4	3	5	5	2	1	10	0	4	9	13
	5	0	3	1	0	0	4	0	1	3	4
Total		5	25	10	4	8	28	3	14	23	40

Note. Satisfaction level 3, 4, and 5 represent *moderately satisfied*, *satisfied*, *very satisfied.*

Table 4.22

Descriptive Statistics of Number of Quality Shoes within a Consideration Set by Acceptance and Two Satisfaction Levels

	Acceptance			Satisfaction to Final Choice			Satisfaction of Selection Procedure			Total
	Deny	Agree	Accept	3	4	5	3	4	5	
M	3.40	3.00	3.60	3.50	2.50	3.36	2.00	3.14	3.39	3.20
SD	0.894	1.258	0.843	0.577	1.195	1.129	1.732	1.027	1.076	1.137
n	5	25	10	4	8	28	3	14	23	40

Note. Satisfaction level 3, 4, and 5 represent *moderately satisfied*, *satisfied*, *very satisfied respectively.*

Table 4.23

Chi-square and Fisher's Exact Test for Evaluating the Association between Number of Quality Shoes and Acceptance and Two Satisfaction Levels

	Acceptance			Satisfaction of Final Choice			Satisfaction of Selection Procedure		
	Value	*df*	*p*	Value	*df*	*p*	Value	*df*	*p*
Pearson Chi-Square	6.546	10	.768	10.267	10	.417	16.782	10	.079
Fisher's Exact Test	6.842		.820	9.132		.522	9.879		.458

CHAPTER 5

DISCUSSION

As the data analysis and result sections were presented and discussed in three separate stages, the discussion section was also presented by: the first stage for evaluating the consideration set, the second one for evaluating the AHP method, and the last one for evaluating the relationship between the two stages. For each stage, the results of descriptive and inferential analyses were interpreted by supporting or not supporting original hypotheses and further by comparing the findings of the study with other researchers' findings. The problems and limitations of the interpretation, which might have come from the research design, the data collection procedures, or other sources, were explained, when necessary. After arguments in these stages, the implication of the study was described by providing further application of a new decision making method, the AHP method, to the Kinesiology field.

Discussion of the First Stage

In the first stage, the discussion consists of three parts: the first part about shoe attributes, the second part about the number of quality shoes in a consideration set, and the last part about the selection of three different sets of shoes, such as five choices within a consideration set, three better choices, and best choice.

First of all, shoe attributes were analyzed descriptively. In Table 4.2, most participants (26 out of 40) selected *comfort* as the discriminating criterion—the most important attribute in selecting five pairs of athletic shoes as walking shoes to form a consideration set. *Fashion* was the second most frequent choice (7 out of 40).

However, no one chose *technical features* as the discriminating criterion. Only one and two participants selected *price* and *brand,* respectively. In Table 4.3, *comfort* and *fit* were treated mostly as an *important* or *very important* attribute. But most participants did not regard *technical features* or *brand* as *important* or *very important* attributes. These descriptive findings on shoe attributes are supported by the NPD group's 2008 sales report. When responding to the question, "Why did you choose this brand of athletic shoes?" in that study, consumers said that comfort or fit was the primary influence on their athletic shoes purchases. *Fashion* and *style* was placed second as purchase influencers. These findings indicate that people tended to select quality athletic shoes first, but also with fashion in their mind. Consumers do not care much about *technical features* and *brand* in selecting athletic shoes. If no discrepancy exists between actual and perceived (or intended) choices, they are not supposed to be distracted by *technical features* and *brand* of athletic shoes. Meanwhile, it was observed in this study that, when actually happened in selecting athletic shoes for walking, participants might be easily distracted by *technical features* and *brand* because they had insufficient or no information on many athletic shoes newly entered into the market. This distracted way of making choices is discussed in the last part of the first stage by investigating which attributes were significant in selecting athletic shoes for walking.

Associations of shoe attributes with gender and age were also represented in the two tables discussed above. A major difference in the effect of *fashion* was found between the two genders (see Table 4.2). Six female participants (30%) selected

fashion as their discriminating criteria. No male participant selected fashion as a discriminating criterion. Another gender difference was found in *comfort*. More males (15 cases) selected comfort than females (11 cases). No conspicuous difference in discriminating criteria was found between two age groups. Only minor differences were detected in *brand* (2 cases for the younger group and none for older group) and *comfort* (12 cases for the younger group and 14 cases for the older group). The associations of the importance of shoe attributes with gender and age were found in the following three combinations: comfort by gender (19 cases of *very important* for male, 12 cases of *very important* for female), fashion by age (9 cases of *important*, 4 cases of *very important* for the younger group; 6 cases of *little important*, 9 cases of *moderately important* for older group), and brand by age (7 cases of *moderately important or above* for the younger group, 13 cases of *moderately important or above* for the older group; see Table 4.3). The previous research mostly supported the results represented in these two tables. Females focus more on the appearance of a product such as style, design, and brand name while males tend to consider internal factors such as comfort and quality as more important factors (Solomon, & Schopler, 1982; Taylor, & Cosenza, 2002). Different age groups chose athletic shoes for different purposes. While fashion plays a large role in shaping young people's appearance and features in terms of their use of athletic shoes, the older population uses athletic shoes for daily use (Pribut, & Richie, 2002).

Next, the consideration set was evaluated using the number of quality shoes within the consideration set (see Table 4.4). Descriptively, some differences between

subgroups of age and gender were detected, but those differences were not statistically significant. The only meaningful effect was found in the interaction between age and gender. Within the male group, the older age group selected more quality shoes (*M* = 3.60, *SD* = 0.843) than the younger group (*M* = 3.10, *SD* = 0.738). However, in the female group, the younger group selected more quality shoes (*M* = 3.70, *SD* = 1.252) than the older group (*M* = 2.40, *SD* = 1.265). The difference between two age groups was much larger within the female group than within the male group. The greater difference in the female group, however, might come from larger standard deviation in female group (*SD* = 1.395) than the male group (*SD* = 0.813). This female group result is different from what is typically expected in terms of selecting athletic shoes—older people place more importance on quality in their choices of athletic shoes than younger people. Compared to other groups, the older females selected the least number of quality shoes to form consideration sets. It might be interpreted that older women can be distracted most because of insufficient knowledge on recent athletic shoes newly entered into the market. This interpretation, however, has some limitations because of the large variability within the female group. For males, the number of quality shoes was between two and four except for one case of five. For females, however, more exceptional numbers (30%) were included: three cases of five and three cases of zero or one (see Table 4.4). Though those exceptional numbers caused large variability, some systematic difference was also found between two age groups among females. Among these exceptional numbers, such as zero, one, or five in the number of quality shoes, the high number (five) came from the younger age group

and the low numbers (zero or one) came from the older age group. The unexpected result for the female group might come from this systemic difference in exceptional numbers of quality shoes within a consideration set between the two age groups. Still, it is hard to say what caused that systemic difference—if it actually exists—in exceptional numbers of quality shoes. Further studies are needed to figure out why exceptional numbers of quality shoes were selected.

Lastly, the discussion is about how a participant selected shoes before and after the shoe-test in the two shoe-selection steps: in the first step, the selection of a consideration set before the shoe-test and in the second step, the further selection of a consideration set (three better choices and then best choice) after the shoe-test. In the descriptive analysis for the first step (see Table 4.5), the difference in selecting a consideration set was detected between the two categories (*major* and *nonmajor brand*) of brand and between the two categories (*no* and *yes*) of technical feature. In the hypothesis test for the first step (see Table 4.7), brand and technical feature were statistically significant shoe attributes in predicting whether each shoe is selected as a consideration set or not without the shoe-test (see Table 4.7). These descriptive and inferential analysis results indicate that there was some discrepancy between perceived and actual selection of athletic shoes. Even though participants did not to care much about technical features and brand in their selecting athletic shoes for walking as discussed above, those two attributes were only statistically significant in the hypothesis test. The shoe selections for forming a consideration set without the

shoe-test might be influenced by the two distracting attributes, such as technical features and brand, although they wanted to disregard those attributes.

This distracted way of forming a consideration set could be explained in two ways. First, without testing shoes, consumers might have trouble finding quality shoes that can be detected after the shoe-test or at least trying them on. More information is needed to make a rational choice among alternatives. It is, however, impossible to process all available information to make a decision. Actually, a decision maker becomes not rational, but rationally bounded, in his or her decision making (Simon, 1955, 1956; Newell, & Simon, 1972). A decision maker usually relies on simplified rules of thumb in the process of decision making (Simon, 1955). In forming a consideration set, it is natural that a consumer, as a decision maker, should rely on a simplified rule that he or she selects shoes according to one or two perceivable attributes such as technical features and brand.

Second, people often believe that athletic shoes are technically advanced and have good quality (Vanderbilt, 1998). When consumers look for quality shoes that are comfortable, well-fitting, and high performing, it is natural that they select athletic shoes. Based on this belief, they may not worry about quality of shoes. Their choices can be influenced by perceivable attributes. Among those perceivable attributes, technical features and brand could influence most in selecting athletic shoes. Most of technical features are gimmicks that make athletic shoes more expensive (Pribut, & Richie, 2004). Though technical features do not do much for quality, they were a good tool for marketing. Vanderbilt (1998) explained that “Investing in the creation and

strong marketing of these technologies provides credibility to companies that their products will actually help with true athletic performance, and thus help give a specific brand an aura of being an authentic athletic brand" (p. 52). Each athletic shoe brand has its own technical features (e.g., Gel Cushioning System [Asics], Pro-moderator [Adidas], DuoCell [Puma], Shox [Nike]) that become major marketing tools.

For the second step, technical features and quality were significant attributes in predicting whether each shoe of a consideration set was selected as a preferred choice or not (see Tables 4.8). Brand was not significant but close to statistically significance (p = .069). In terms of the significance of the four shoe attributes, there was no big difference between the first and second shoe selection step. The four shoe attributes played similar roles in selecting shoes in both steps. The difference was detected in shoe quality, the newly added attribute in the second step. Quality was an additional significant attribute in making further choices among the consideration set after the shoe-test. Among the shoe quality scores (2 to 5), the lowest score was different from other scores in the frequency of the three shoe-choice sets (see Table 5.6). In the parameter estimation for GEE model of the second step, the same phenomenon was found: The lowest quality score was significantly different from other scores in selecting the three shoe-choice sets from the consideration set.

A consumer needs to form a good consideration set of athletic shoes for walking to make a good final choice. Even though a consumer as a decision maker wants to select a good quality walking shoe, it is impossible or difficult to make a good final choice if there are no or a small number of quality shoes within a consideration

set. Keller and Staelin (1987) introduced two types of risks in making a consideration set. One risk is that decision makers might easily eliminate alternatives that need to be included in the consideration set. Because of this risk, they cannot reach an optimal consideration set that includes all qualified alternatives. The other risk is that decision makers can include the alternatives that need to be excluded from the consideration set. As a result of this risk, decision makers waste their efforts to find unnecessary alternatives. The two risks compensate each other in making a consideration set. The more alternatives, the lower the first risk but the higher the second risk. In selecting athletic shoes for walking, a consumer cannot test all athletic shoes on the shelf of a retail store to form a good consideration set. To reduce both of the risks, a consumer needs to use a simplified quality test for athletic shoes. A consumer can eliminate unqualified shoes without much effort by evaluating selected shoes to form a consideration set using a simple quality test. In this study, no direct comparison was conducted between using and not using a shoe-quality test in forming a consideration set. Further studies need to be performed to figure out whether a simple quality test makes a difference in actually selecting the athletic shoes that are good in quality and perceived as preferred.

Discussion of the Second Stage

In this stage, decision making with the support of AHP was discussed in three sections: the consistency of preference, the effectiveness of AHP, and the satisfaction of AHP. Actually, it is difficult for a consumer to make a good decision considering all

decision criteria properly according to his or her preference perception. AHP has been used as an effective tool to help a consumer make a good decision.

Consistency of Preference

A good decision should be consistent with a decision maker's preference (Johnson & Payne, 1985; Tabatabaei, 2002). Consistency, as a measure of performance, represents how much decision outcomes are consistent with a decision maker's stated preferences. Consistency index was calculated by the similarity of preference scores between the self-explication (preference without the support of AHP) and AHP (preference with the support of AHP) for two different situations: making best choice and three better choices from a consideration set after testing all five shoes included in a consideration set. The consistency indicates how close the preference score of a best choice of the self-explicate method (self-explicate choice) is to the preference score of a recommended choice of the AHP method (AHP choice).

For the first situation, the consistency index got smaller as the deviation of preference scores between an AHP choice and a self-explicate choice gets larger (see Tables 4.9 and 4.10). The consistency index reached the maximum (1.000) when an AHP choice was equal to a self-explicate choice. The overall consistency was high (M = 0.863)—among all possible difference (100%) in preference scores between the two choices, 13.7% of the average difference in preference scores was observed with the relatively large variability (SD = 0.249). Though large mean differences of the consistency indexes were found descriptively between two gender and age subgroups, as well as their interaction, none of them was statistically significant. These results

were caused by greater standard deviations than the mean differences. The large standard deviations occurred due to the large range (0.920) between the minimum (0.080) and maximum (1.000) consistency index. For some participants, big differences of preference scores were found between the choices made with and without the help of the AHP method. Those persons may have trouble in selecting athletic shoes for walking according to their preferences, which can be figured out by evaluating multiple alternatives according to multiple shoe attributes. The AHP method can be a helpful tool for them to make choices according to their preferences.

For the second situation, the consistency index represents the deviation of summed preference scores between three recommended choices of AHP and three better choices of the self-explicate method (see Tables 4.11 and 4.12). The maximum consistency was 1.000 when three better AHP choices are equal to three better self-explicate choices. Compared to the first situation, the mean consistency was higher (*M* = 0.942) and variability was smaller (*SD* = 0.112). When the participants made three choices, very small differences (only 5.8% out of 100%) in summed preference scores were detected between the choices made with and without the support of the AHP method, which means that they did not have much trouble in making three choices from a consideration set according to their preferences. Even though the consistency between three self-explicate and AHP choices was high, there is still a possibility that this high consistency came from the fact that participants made three choices from the consideration set (only five pairs of shoes) that were already selected from the selection pool. Because they already selected those five pairs of shoes according to

their decision criteria, the five alternatives were supposed to be similar, which was an expected problem in their forming consideration set was that they made five choices without the shoe-test. It is natural that participants should not have much difficulty in making three choices according to their preferences without the help of the AHP method even though they selected those three shoes after the shoe-test. As mentioned above in the first situation, when participants made one choice, there existed some more room for the improvement of their selections with the support of the AHP method.

Further analyses of the consistency were conducted between the subgroups of gender and age. Much smaller mean differences in the consistency index were found between gender and age subgroups, as well as their interaction, than the mean differences for the first situation because of much smaller standard deviations and range (0.530).

Effectiveness of AHP

The effectiveness of AHP as a decision support system can be examined by comparing an actual and expected choice (Evans & Riha, 1989). If a decision maker makes an expected choice as his or her actual choice, the DSS works effectively (Rhee & Rao, 2008). In selecting walking shoes, an expected choice could be an AHP choice and an actual choice could be a final choice. Two measures, such as agreement and acceptance, were calculated to evaluate the effectiveness of the AHP method. The agreement is similar to the consistency index. Both of them evaluate a similarity between an AHP choice and a self-explicate choice. The difference between the two

measures is that the agreement evaluates the exact match of selected shoes between an AHP choice and a self-explicate choice, and the consistency measures the similarity of preference scores between the two choices. In terms of the agreement, a self-explicate choice was equal to an AHP choice in 25 cases out of 40 (see Tables 4.13 and 4.14). The acceptance evaluates whether a participant accepted an AHP choice as his or her final choice or not when the two choices were different. Out of 15 cases of selection differences, 10 participants (66.7%) accepted recommended shoes of the AHP method as their final choices, which means that 10 participants changed their final choices to AHP choices. This finding indicates that those participants thought that recommended choices of the AHP method could be better choices than their choices made without the support of the AHP method. Combining agreement and acceptance, 35 participants (87.5%) selected AHP choices as their final choices, which shows that AHP was effective in making a final choice of walking shoe.

Satisfaction of AHP

The last way of evaluating AHP was to measure the satisfaction of the AHP method. Two types of satisfactions were measured: first, the satisfaction of the selection procedure including the AHP method and second, the satisfaction of the final choice. The association was evaluated between the two satisfaction measures and four variables such as age, gender, consistency and acceptance.

For the first type of satisfaction, the satisfaction level for all participants was high: 37 participants (92.5%) were *satisfied* or *very satisfied* (see Tables 4.15 and 4.16). Most participants felt satisfied with the whole procedure of selecting walking shoes

including the AHP method. In the relationship with four variables such as age, gender, the consistency index, and the acceptance (three categories: *agree*, *accept*, *deny*), the satisfaction level had no significant relationship with age, the two consistency indexes (the one for a most preferred choice and the other for three preferred choices), and the acceptance. Only the relationship with gender was statistically significant: male participants were more satisfied with the selection procedure than female participants.

For the second type of satisfaction, the satisfaction level for all participants was very high: 28 participants (70.0 %) were *very satisfied* and eight participants (20%) were *satisfied* (see Tables 4.17 and 4.18). The remaining 10 % of participants were *moderately satisfied*. In the relationship with four variables, the satisfaction level represented no significant relationship with age and the two consistency indexes. The relationship of the satisfaction level with gender was significant, and the association with the acceptance was significant in a Fisher's exact test and very close to statistically significant (p = .062) in the Chi-square test. For the satisfaction to the final choice, answering patterns were different between male and female participants. More males (3 cases, 15%) answered *moderately satisfied* (3 in a 5-point Likert scale) than females (1 case, 5%). More males (16 cases, 80%) also answered *very satisfied* (5 on a Likert scale) than females (12 cases, 60%). Between two categories (*deny* and *accept*) of the acceptance, different answering patterns were detected. The satisfaction level of the *accept* category (8 cases of *very satisfied* in 10 cases) were higher than that of the *deny* category (2 cases of *moderately satisfied* and 2 cases of *satisfied* in 5 cases). This result indicates that the participants, who denied the

recommended choices of the AHP method, felt less satisfied than the people who accepted recommended choices of the AHP method.

The two-step shoe selection, which was applied to this research, includes several limitations: forming a consideration set from a selection pool, conducting a lot of pair-wise comparisons for the AHP method, and testing five pairs of shoes included in a consideration set. These procedures take more time and more effort to select one pair of walking shoes. In real purchasing situations, people do not want to use this complicated method to buy walking shoes even though they can make a better choice. Though participants were satisfied with the selection procedure of this research, it does not mean they will use this procedure in real purchasing situations. There should be some additional research for applying the two-step shoe selection strategy to real athletic shoe markets. In the future, a new system for reducing time and effort that can integrate with AHP needs to be developed to conduct the two-step shoe selection procedure.

Discussion of Across Two Stages

Across two stages, the association between the first stage and second stage was examined: the associations between the number of quality shoes within a consideration set and three different measures, such as the two types of consistency indexes, the acceptance, and the two kinds of satisfactions, calculated in the second stage.

In the association with the consistency index for three preferred choices, the number of quality shoes within a consideration set did not show statistical significance

(see Tables 4.19 and 4.20). No specific pattern was detected descriptively in the consistency index across the number of quality shoes. One noticeable finding was that the standard deviation of the consistency index gets larger as the number of quality shoes gets higher. When more quality shoes were included in a consideration set, people made three better choices in different ways. Discrepancies in preference scores between three AHP choices and three self-explicate choices varied a lot; some participants were distracted by many quality shoes included in a consideration set in their making three preferred choices from a consideration set, and others were not distracted. When a smaller number of quality shoes were included in a consideration set, most of participants made three choices in similar ways.

In the relationship with the consistency index of best choice, the number of quality shoes within a consideration set showed a statistical significance. The two variables were correlated negatively. As the number of quality shoes got higher, the consistency index got lower. When many quality shoes were included in a consideration set, participants had trouble in selecting one most-preferred shoe according to their intended preferences. After testing shoes within a consideration set, they might have felt confused about how to make best choice from several good quality shoes within a consideration set.

In the association of the number of quality shoes with acceptance (see Tables 4.21-4.23), the contingency table shows that among three categories of acceptance, fewer quality shoes were included in a consideration set for the *agree* category (*M* = 3.00; an exact match in best choice between the self-explicate and AHP) than for

other two categories (*M* = 3.60 for *accept* and *M* = 3.40 for *deny*; the discrepancy in best choice between the self-explicate and the AHP method). This result indicates that a participant had less difficulty in making best choice according to his or her expected preference when there were fewer quality shoes. In other words, they felt less confident (or more confused) in making best choice according to their expected (or perceived) preferences when more quality shoes were included in a consideration set after testing all five shoes within a consideration set. This interpretation, however, has limitations because of greater variance in the number of quality shoes within the *agree* category (*SD* = 1.258) than within the *accept* (*SD* = 0.843) or *deny* categories (*SD* = 0.894). The large standard deviation occurred because the number of quality shoes for the *agree* category ranged widely from zero (minimum) to five (maximum). More lower-extreme-values, such as zero and one in the number of quality shoes, were in the *agree* category than in other categories. Descriptively, some mean differences in the number of quality shoes among the three categories of acceptance were detected, but the differences were smaller than the standard deviations. The relationship of the number of quality shoes with acceptance was not statistically significant.

In the relationship of the number of quality shoes with satisfaction of the selection procedure, the contingency table (see Tables 4.21 and 4.22) shows the pattern that the more quality shoes, the higher the satisfaction. When more quality shoes were included within a consideration set, participants felt more satisfied with the selection procedure, even though they did not know how many quality shoes were included in a consideration set. The association (*p* = .079) between two variables,

however, was not significant but close to the significant level ($p < .050$) in the Chi-square test (see Table 4.23).

In the relationship of a number of quality shoes with the satisfaction of the final choice (the second satisfaction), the contingency table (see Tables 4.21 and 4.22) did not show a noticeable pattern. No statistically significant association was detected between the two variables (see Table 4.23). Even though participants selected more quality shoes in a consideration set, their satisfaction level was not influenced by the number of quality shoes when they made the final choice among the five alternatives of a consideration set.

Conclusion

According to the findings of this study, the following conclusions were made about the consideration set, AHP, and the relationship between the consideration set and AHP:

1. When forming a consideration set before the shoe-test without the support of the AHP, *technical features* and *brand* was significant among the four shoe attributes in which *quality* was not included as a shoe attribute because it could not be perceived before the shoe-test. In making further preferred choices from the consideration set—three better choices first and then best choice—after the shoe-test without the support of the AHP, quality, a newly added shoe attribute after the shoe-test, and technical feature played significant roles.

2. No significant difference in the number of quality shoes within a consideration set was detected between subgroups of *age* and *gender*. A significant interaction effect was found between age and gender.
3. The AHP was a helpful tool to help participants make good decisions—selecting quality athletic shoes for walking based on their perceived preferences—in the three measures for evaluating the AHP: the consistency of preference, the effectiveness of the AHP, and the satisfaction with the AHP.
4. The number of quality shoes within a consideration set showed a statistical significance in the association with the consistency index for best choice but no statistical significance in the relationship with the consistency index of three better choices. The relationship of the number of quality shoes with the acceptance and the satisfaction was also not significant.
5. In this study, the AHP was successfully applied to a typical MCDM together with two-stage selection. AHP can be applied to many MCDM areas of Kinesiology as DSS. In the review of Vaidya and Kumar (2006), the themes discussed were selection, evaluation, benefit–cost analysis, allocations, planning and development, priority and ranking, and decision-making. These themes, as well as some possible examples, can be found in many research areas of Kinesiology as follows:

    - Selection

    - Selection of a school, a team, or a program as an athlete
    - Selection of an instrument for measuring physical activity or fitness
    - Consumer behavior in purchasing sporting gears and clothing
- Evaluation
    - Evaluation of athletic programs in a school
    - Evaluation of tools used for measuring obesity
- Allocation
    - Allocation of resources for building up a team
    - Allocation of funds for new research
- Priority and ranking
    - Making priorities of factors for improving physical fitness in a school
    - Deciding rankings for schools in a conference
- Cost-benefit analysis
    - Cost-benefit analysis for buying a new measurement tool
    - Cost-benefit analysis for administrating a new program for reducing obesity in children
- Decision-making
    - Decision-making for changing a treatment method for injury recovery
    - Decision-making for adding a sport program

It is expected that there should be a significant increase of AHP applications in Kinesiology with the efforts like this study.

REFERENCES

Adelman, L. (1992). *Evaluating decision support and expert systems.* New York: John Wiley & Sons.

Ainsworth, B. E., Haskell, W. L., Leon, A. S., Jacobs, D. R., Jr., Montoye, H. J., Sallis, J. F., et al. (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine & Science in Sports & Exercise, 25*, 71-80.

American Academy of Orthopaedic Surgeons. (n.d.). *Footwear guide.* Retrieved March 12, 2009, from http://orthoinfo.aaos.org/topic.cfm?topic=A00145

American Academy of Podiatric Sports Medicine. (n.d.). Recommended shoes. Retrieved April 15, 2009, from http://aapsm.org/crishoe.html

American Orthopaedic Foot & Ankle Society. (2008). *Survey shows runners commonly experience shoe related injuries: Cost of shoes bears little relationship to these injuries*. Retrieved March 7, 2009, from http://www.aofas.org/Scripts/4Disapi.dll/4DCGI/cms/review.html?Action=CMS_Document&DocID=232

Armacost, R.L., & Hosseini, J.C. (1994). Identification of determinant attributes using the analytic hierarchy process. *Journal of the Academy of Management Science*, *22*(4), 383-92.

Bahmani, N., Javalgi, R.G., & Blumburg, H. (1986). An application of the analytical hierarchy process for a consumer choice problem. *Developments in Marketing Science, 9*, 402-406.

Barnes, R. A., & Smith, P. D. (1994). The role of footwear in minimizing lower limb injury. *Journal of Sports Sciences*, *12*(4), 341-353.

Barrett, J., & Bilisko, T. (1995). The role of shoes in the prevention of ankle sprains. *Sports Medicine, 20*, 277-280.

Batty, G. D., Shipley, M. J., Marmot, M., & Davey-Smith, G. (2002). Physical activity and cause-specific mortality in men with type 2 diabetes/impaired glucose tolerance: Evidence from the Whitehall study. *Diabetic Medicine, 19*(5), 80-88.

Beach, L. R., & Mitchell, T. R. (1978). A contingency model for the selection of decision strategies*. Academy of Management Review, 3*, 439-449.

Ben-Akiva, M. & Boccara, B. (1995). Discrete choice models with latent choice sets. *International Journal of Research in Marketing, 12*, 9-24.

Bettman, J. R. (1977). Data collection and analysis approaches for studying consumer information processing. In W. D. Perault (Ed.), *Advances in Consumer Research Vol. 4* (pp. 342-348). Atlanta: Association for Consumer Research.

Bharati, P., & Chaudhury, A. (2004). An empirical investigation of decision-making satisfaction in web-based decision support systems. *Decision Support Systems, 37* (2), 187-197.

Billings, R. S., & Scherer, L. L. (1988). The effects of response mode and importance on decision-making strategies: Judgment versus choice. *Organizational Behavior and Human Decision Processes, 41*, 1–19.

Boone, T. (2007). *Walking and injuries*. Retrieved January 28, 2009, from http://health.howstuffworks.com/walkingandinjuries.htm

Brassington, F., & Pettitt, S. (2000). *Principles of Marketing* (2nd ed.). Harlow: Prentice Hall

Brisoux, J. E., & Laroche, M. (1981). Evoked set formation and composition: An empirical investigation under a routinized response behavior situation. In Kent B. Monroe (Ed.), *Advances in consumer research* (pp. 357–361). Provo, UT: Association for Consumer Research.

Brown, J.J., & Wildt, A.R. (1992). Consideration set measurement. *Journal of the Academy of Marketing Science, 20*, 235-43.

Bumgardner, W. (2008). *Walking shoe and boot preference poll results.* Retrieved March 21, 2009, from http://walking.about.com/cs/shoes/a/shoepoll951.htm

Calantone, R.J., Di Benedetto, C.A., & Schmidt, J.B. (1999). Using the analytic hierarchy process in new product screening. *Journal of Product Innovation Management, 16*, 65-76.

Caspersen, C. J., Powell, K. E., & Christensen, G. M. (1985). Physical activity, exercise and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*, 126-131.

Cavanagh, P. R. (1980). *The running shoe book.* Mountain View: Anderson World.

Cavanagh, P. R. (1987). The biomechanics of lower extremity action in distance running. *Foot and Ankle, 7*, 197-217.

Clinghan, R., Arnold, G. P., Drew, T. S., Cochrane, L. A., & Abboud, R. J. (2008). Do you get value for money when you buy an expensive pair of running shoes? *British Journal of Sports Medicine, 42*, 189-193.

Cook, T., Falchi, P., & Mariano, R. (1984). An urban allocation model combining time series and analytic hierarchical methods. *Management Science*, *30*(2), 198-208.

Coughlin, M. J. (1996). Women's shoe wear and foot disorders. *Western Journal of Medicine, 163*(6), 569-570.

Cramer, D. (1997). *Basic statistics for social research: Step by step calculations and techniques using minitab*. London: Routledge.

Davies, M. (2001). Adaptive AHP: A review of marketing applications with extensions. *European Journal of Marketing*. *35*, 872-893.

Dyer, R.F., Forman, E.H., & Mustafa, M.A. (1992). Decision support for media selection using the analytic hierarchy process. *Journal of Advertising, 21*(1), 59-72.

Einhorn, H. J. (1970). The use of nonlinear, noncompensatory models in decision making. *Psychological Bulletin, 73*, 211-30.

Einhorn, H. J. (1971). Use of nonlinear, noncompensatory models as a function of task and amount of information. *Organizational Behavior and Human Performance, 6*, 1-27.

Enoka, R. M. (2008). *Neuromechanics of human movement* (4th ed.). Champaign, IL: Human Kinetics.

Evans, G., & Riha, J. R. (1989). Assessing DSS effectiveness: Using evaluation research methods. *Information & Management, 16*(4), 197-206.

Eyler, A. A., Brownson, R. C., Bacak, S. J., & Housemann, R. A. (2003). The epidemiology of walking for physical activity in United States. *Medicine & Science in Sports & Exercise, 35*(9), 1529-1536.

Ford, J. K., Schmitt, N., Schechtman, S. L., Hults, B. H., & Doherty, M. L. (1989). Process tracing methods: Contributions, problems, and neglected research questions. *Organizational Behavior and Human Decision Processes, 43(1)*, 75-117.

Forman, E. H., & Gass, S. I. (2001). The Analytic Hierarchy Process–An Exposition. *Operations Research, 49*(4), 469-486.

Frey, C., Thomson, F., Smith, J., Sanders, M., & Horstman, H. (1993). American orthopedic foot and ankle society women's shoe survey. *Foot and Ankle, 14*(2), 78-81.

Ghodsypour, S.H., & O'Brien, C. (1998). A decision support system for supplier selection using an integrated analytic hierarchy process and linear programming. *International Journal of Production Economics, 56-57*(1), 199-212.

Gregg, E. W., Gerzoff, R. B., Caspersen, C. J., Williamson, D. F., & Narayan, K. M. (2003). Relationship of walking to mortality among U. S. adults with diabetes. *Archives of Internal Medicine, 163*, 1440-1447.

Hakim, A. A., Petrovitch, H., Burchfiel, C. M., Ross, W. G., Rodriguez, B. L., White, L. R., et al. (1998). Effects of walking on mortality among nonsmoking retired men. *New England Journal of Medicine, 338*, 94-99.

Hamilton, N., & Luttgens, K. (2002). *Kinesiology, scientific basis of human motion* (10th ed.). Boston: McGraw-Hill.

Hardin, J., & Hilbe, J. (2003). *Generalized Estimating Equations*. London: Chapman and Hall/CRC.

Harris, R. (2008, October 17). *Introduction to decision making.* Retrieved May 20, 2009, from http://www.virtualsalt.com/crebook5.htm

Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical activity and public health: Updated recommendation for adults from the American college of sports medicine and the American heart association. *Medicine & Science in Sports & Exercise, 39*(8), 1423-1434.

Haubl, G., & Trifts, V. (2000). Consumer decision making in online environments. *Marketing Science, 19* (Winter), 4-21.

Hauser, J.R., & Wernerfelt, B. (1990). An evaluation cost model of consideration sets. *Journal of Consumer Research, 16*(4), 393-408.

Hawkins, D. E., Best, R. J., & Coney, K. A. (2001). *Consumer behavior: Building marketing strategy* (8th ed.). Columbus: McGraw-Hill.

Howard, J. A., & Sheth, J. N. (1969). *The theory of buyer behavior*. New York: John Wiley & Sons.

Hoyer, W. T., & MacInnis, D. (1997). *Consumer behavior*. Boston: Houghton Mifflin.

International Society on Multiple Criteria Decision Making. (n.d.). Call for papers special issue on multiple criteria decision making and decision support systems: Selected papers from the 20th international conference on multiple criteria decision making. Retrieved May 5, 2009, from http://www.elsevierscitech.com/pdfs/CFP_DSS_MCDM_Shi.pdf

Johnson, E. J., & Payne, J. W. Effort and Accuracy in Choice. (1985). *Management Science, 31*(4), 395-414.

Jones, B. D. (1994). *Reconceiving decision-making in democratic politics.* Chicago: University of Chicago Press.

Jones, B. D. (1999). Bounded rationality. *Annual Review of Political Science, 2*, 297-321.

Kahn, E. B., Ramsey, L. T., Brownson, R. C., Heath, G. W., Howze, E. H., Powell, K. E., et al. (2002). Effectiveness of interventions to increase physical activity. A systematic review. *American Journal of Preventive Medicine, 22*, 73-107.

Kang, S. (2006). Sports shoe rivals step up. *The Wall Street Journal*, January 6.

Keller, K. L., & Staelin, R. (1987). Effects of quality and quantity of information on decision effectiveness. *Journal of Consumer Research, 14*, 200-213.

Koncept Analytics. (n.d.) *Strong fashion orientation of athletic retail market*. Retrieved March 21, 2009, from http://www.researchandmarkets.com/reports/553106/strong_fashion_orientation_of_athletic_retail

Kotler, P. (1988). *Marketing management - analysis, planning, implementation, and control* (6th ed.). Englewood Cliffs, NJ: Prentice-Hall.

Kotler, P., Swee, H. A., Siew, M. L., & Chin, T. T. (1994). *Marketing management: An Asian perspective* (8th ed.). Englewood Cliff, NJ: Prentice-Hall.

Langer, P. (2007). What is comfort? *Performance Sports Retailer*. Retrieved from http://www.sportsonesource.com/news/psr/downloads/psr07/PSR_0701low.pdf

Laroche, M., Kim, C., & Matsui, T. (2003). Which decision heuristics are used in consideration set formation? *Journal of Consumer Marketing, 20* (3), 192-209.

Laroche, M., Rosenblatt, J., Jacques, E. B., & Robert, S. (1983). Brand categorization strategies in RRB situations: Some empirical results. *Advances in Consumer Research, 10*, 543-554.

Lee, I. M., Rexrode, K. M., Cook, N. R., Manson, J. E., & Buring, J. E. (2001). Physical activity and coronary heart disease in women: Is "no pain, no gain" passé? *JAMA, 285*, 1447-1454.

Liang, K. Y., & Zeger S. (1986). Longitudinal Data Analysis Using Generalized Linear Models. *Biometrika*, *73*(1), 13–22.

Lilien, G.L., Rangaswamy, A., Van Bruggen, G. H., & Starke, K. (2004). DSS effectiveness in marketing resource allocation decisions: reality vs. perception. *Information Systems Research, 15*(3), 216-235.

Lipsey, R. A. (2006). *The sporting goods industry: History, practices and products.* Jefferson, NC: McFarland & Company, Inc.

Maier, T., & Pietrocarlo, T. (1991). The foot and footwear. *The Nursing Clinics of North America*, *26*(1), 223-231.

Marti, B. (1989). Relationships between running injuries and running shoes – results of a study of 5,000 participants of a 16-km run – the May 1984 Berne 'Grand Prix'. In B. Segesser, & W. Pforringer (Eds.), *The shoe in sport* (pp. 256-265). Chicago: Year Book Medical Publishers.

May, F.E. (1979). Evoked set formation and composition: The learning and information processing hypotheses. In Wilkie, W.L. (Ed.), *Advances in Consumer Research Vol. 6* (pp. 222-226). Ann Arbor: Association for Consumer Research.

May, F. E., & Homans, R. (1977). Evoked sets size and the level of information processing in brand comprehension and choice criteria. In W. D. Perault (Ed.), *Advances in Consumer Research Vol. 4* (pp. 172-175). Atlanta: Association for Consumer Research.

Mayo Clinic staff. (n.d.). *Walking shoes: Features and fit that keep you moving.* Retrieved Feb. 2009, from MayoClinic.com: http://www.mayoclinic.com/health/walking/HQ00885_D

Merriam-Webster's Collegiate Dictionary. (1993). (10th ed.). Springfield: Merrian-Webster, Inc.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63*, 81-97.

Mintz, A., Geva, N., Redd, S. B., & Carnes, A. (1997). The effect of dynamic and static choice sets on political decision making: An analysis using the decision board platform. *American Political Science Review, 91*, 553-566.

Mowen, J. C., & Minor, M. (1998). *Consumer behavior* (5th ed.). Upper Saddle River, NJ: Prentice-Hall.

Mundemann, A., Stefanshyn, D. J., & Nigg, B. M. (2001). Relationship between footwear comfort of shoe inserts and anthropometric and sensory factors. *Medicine & Science Sports & Exercise, 33*, 1939-1945.

Narayana, C. L., & Markin, R. J. (1975). Consumer behavior and product performance: An alternative conceptualization. *Journal of Marketing, 39*, 1-6.

Newell, A., & Simon, H. A. (1972). *Human problem solving.* Englewood Cliffs, NJ: Prentice-Hall.

Nigg, B. M., & Segesser, B. (1992). Biomechanical and orthopedic concepts in sport shoe construction. *Medicine & Science in Sports & Exercise, 24*(5), 595-602.

Olshavsky, R. W. (1979). Task Complexity and Contingent Processing in Decision Making: A Replication and Extension. *Organizational Behavior and Human Performance*, 24, 300–316.

Parkinson, T. L., & Reilly, M. (1979). An information processing approach to evoked set formation. *Advances in Consumer Research, 6*, 227-231.

Payne, J. W. (1982). Contingent decision behavior. *Psychological Bulletin, 92*, 382-402.

Payne, J.W., Bettman, J.R., & Johnson, E.J. (1988). Adaptive strategy selection in decision making. *Journal of Experimental Psychology: Learning, Memory and Cognition, 14*, 534-552.

Payne, J. W., Bettman, J., & Johnson, E. J. (1993). *The adaptive decision maker*. New York: Cambridge University Press.

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., et al. (1995). Physical activity and public health–a recommendation from the centers for disease control and prevention and the American college of sports medicine. *JAMA, 273*, 402-407.

Power, D. J., & Sharda, R. (2007). Model-driven decision support systems: Concepts and research directions. *Decision Support Systems*, *43*(3), 1044-1061.

Proctor, T. (1996). *Marketing management.* New Jersey: Prentice-Hall, Inc.

Prubit, S. M., & Richie, D. H. (2003). *2002: A sneaker odyssey*. Retrieved March 17, 2009, from http://www.drpribut.com/sports/sneaker_odyssey.html

Prubit, S. M., & Richie, D. H. (2004). *Separating the buzz from the biomechanics: A guide to athletic shoe trends and innovations.* Retrieved March 14, 2009, from http://www.drpribut.com/sports/pributrichie-run-1004.pdf

Reger, B., Cooper, L., Booth-Butterfield, S., Smith, H., Bauman, A., Wootan, M., et al. (2002). Wheeling walks: A community campaign using paid media to encourage walking among sedentary old adults. *Preventive Medicine, 35*, 285-292.

Rhee, C., & Rao, H. R. (2008). Evaluation of decision support systems. In F. Burstein & C. W. Holsapple (Eds.), *Handbook on decision support systems 2* (pp. 313-327). Berlin: Springer.

Richard, K. M. (2007). *The 2008 leisure market research handbook*. Loganville, GA: Richard K. Miller & Associates. Retrieved from http://rkma.com/2008leisureSAMPLE.pdf

Roberts, E. (1990). Evolving toward product and market orientation: The early years of technology based firms. *Journal of Product Innovation Management, 7*(4), 274-287.

Roberts, J. H., & Lattin, J. M. (1991). Development and testing of a model of consideration set composition. *Journal of Marketing Research*, *28*, 429-44.

Roy, B. (1993). Decision science or decision aid science. *European Journal of Operational Research, 66*, 184-203.

Roy, B. (1996). *Multicriteria methodology for decision aiding*. Dordrecht: Kluwer Academic Publishers.

Rubinstein, R. R. (2001). *Dress codes: Meanings and messages in American culture* (2nd ed.). Boulder: Westview Press.

Saaty, T.L. (1980). *The analytic hierarchy process.* New York: McGraw-Hill.

Saaty, T. L. (1986). Axiomatic foundation of the analytic hierarchy process. *Management Science, 32*, 841-855.

Saaty, T. L. (1994a). Fundamentals of decision making. Pittsburgh: RWS Publications.

Saaty, T. L. (1994b). How to make a decision: The analytic hierarchy process. *Interfaces, 24*, 19-43.

Saaty, T. L. (2001). *Decision making with dependence and feedback: The analytic network process* (2nd ed.). Pittsburgh: RWS Publications.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences, 1*(1), 83-98.

Saaty, T. L., & Vargas, L. G. (2000). *Models, methods, concepts & applications of the analytic hierarchy process.* Boston: Kluwer Academic Publishers.

Sauter, V. L. (1997). *Decision support systems: An applied managerial approach.* New York: John Wiley.

Schiffman, L. G. & Kanuk, L. L. (1997). *Consumer behavior* (6th ed.). New Jersey: Prentice Hall, Inc.

Schwartz, B. (2000). Self determination: The tyranny of freedom. *American Psychologist*, *55*, 79-88.

Sesso, H. D., Paffenbarger, R. S., & Lee, I. M. (2000). Physical activity and coronary heart disease in men: Harvard alumni health study. *Circulation, 102*, 975-980.

Sharda, R., Barr, S. H., & McDonnell, J. C. (1988). Decision support system effectiveness: A review and an empirical test. *Management Science, 34* (2), 139-159.

Shorten, M. R. (2000). Running shoe design: Protection and performance. In *Marathon medicine* (pp. 159-169). London: Royal Society of Medicine.

Siegel, P. Z., Brackbill, R. M., & Heath, G. W. (1995). The epidemiology of walking for exercise: Implications for promoting activity among sedentary groups. *American Journal of Public Health, 85*, 706-710.

Silverman, B. G., Bachann, M., & Al-Akharas, K. (2001). Implications of buyer decision theory for design of e-commerce websites. *International Journal of Human Computer Studies, 55*(5), 815-844.

Simon, H. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, *69*(1), 99-118.

Simon, H. (1956). Rational choice and the structure of the environment. *Psychological Review*, 63, 129-138.

Simon, H. (1987). Making management decisions: The role of intuition and emotion. In W. Agor (Ed.), *Intuition in organizations* (pp. 23-39). London: Sage.

Simpson, M. E., Serdula, M., Galuska, D. A., Gillespie, C., Donehoo, R., Macera, C., et al. (2003). Walking trends among US adults: The behavioral risk factor surveillance system, 1987-2000. *American Journal of Preventive Medicine*, *25*, 95-100.

Solomon M., & Schopler J. (1982). Self-consciousness and clothing. *Personality and Social Psychology Bulletin, 8*(3), 508-514.

Sporting Goods Manufacturers Association (SGMA). (2008). *American sports scene: An analysis of sports participation in the U.S.* Press release. Washington, D.C.: Sporting Goods Manufacturers Association.

Stampfer, M., Hu, F., Manson, J., Rimm, E., & Willett, W. (2000). Primary prevention of coronary heart disease in women through diet and exercise. *New England Journal of Medicine, 343*, 16-32.

Stewart, T.J. (1987). Pruning of decision alternatives in multiple criteria decision making, based on the UTA method for estimating utilities. *European Journal of Operational Research, 28*, 79-88.

Stewart, T. J. (1988). Experience with prototype multicriteria decision support systems for pelagic fish quota determination. *Naval Research Logistics, 35*, 719-731.

Stewart, T.J. (1991). A multi-criteria decision support system for research and development project selection. *Journal of the Operational Research Society, 42* (1), 17-26.

Stewart, T. J. (1992). A critical survey on the status of multiple-criteria decision making: Theory and practice. *OMEGA, 20*, 569-586.

Tabatabaei, M. (2002). An experimental analysis of decision channeling by restrictive information display. *Journal of Behavioral Decision Making, 15*(5), 419-432.

Takemura, K. (1985). A meta-cognitive process model for the implementation of decision strategies. *Doshisha Psychological Review, 32*, 16-22.

Tanasescu, M., Leitzmann, M. F., Rimm, E. B., & Hu, F. B. (2003). Physical activity in relation to cardiovascular disease and total mortality among men with type 2 diabetes. *Circulation, 107*, 2435-2439.

Taylor, S.L., & Cosenza, R.M. (2002). Profiling later aged female teens: Mall shopping behavior and clothing choice. *The Journal of Consumer Marketing, 19* (4/5), 393-409.

The Akron Global Polymer Academy. (n.d.) *Designer Sneakers: Student pages short version.* Retrieved March 21, 2009, from http://www.polymerambassadors.org/AkronStudentShort.pdf

The free dictionary by Farlex. (n.d.). Retrieved March 12, 2009, from http://www.thefreedictionary.com/walking+shoe

The NPD Group Inc. (2007). *NPD sees fashion focus driving athletic footwear sales.* Press release. Port Washington, NY: Business Wire. Retrieved from http://findarticles.com/p/articles/mi_m0EIN/is_2007_March_14/ai_n27187198

The NPD Group Inc. (2007). *NPD sees fashion focus driving athletic footwear: Sales by category dollar volume*. Retrieved March 21, 2009, from http://www.fibre2fashion.com/news/images/newspdf/npd_sees_fashion_focus_driving_athletic_footwear_sales_32512_61802.pdf?PDFPTOKEN=c659590

The NPD Group Inc. (2008, September). Consumer habits: People are still purchasing, but where and why? *Sports Insight*. Retrieved March 21, 2009, from http://www.sports-insight.co.uk/npd_reports/2008_09.pdf

Todd, P., & Benbasat, I. (1992). The use of information in decision-making: An experimental investigation of the impact of computer-based decision aids. *MIS Quarterly*, *16*, 373 - 393.

Todd, P., & Benbasat, I. (1999). Evaluating the impact of DSS, cognitive effort, and incentives on strategy selection. *Information Systems Research, 10*(4), 356-374.

Tyrrell, W., & Carter, G. (2009). *Therapeutic Footwear: A Comprehensive Guide.* Edinburgh: Elsevier Limited.

US Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Centers for Chronic Disease Prevention and Health Promotion.

US Department of Health and Human Services. (2002). *Physical activity fundamental to preventing disease.* US Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation.

US Department of Health and Human Services. (2008). *2008 Physical Activity Guidelines for Americans.* ODPHP Publication No. U0036. Retrieved March 21, 2009, from www.health.gov/paguidelines

Vanderbilt, T. (1998). *The sneaker book: Anatomy of an industry and an icon*. New York: The New Press.

Vaidya, O., & Kumar, S. (2006). Analytical hierarchy process: An overview of applications. *European Journal of Operational Research, 169*, 1-29.

Vargas, L. G., & Saaty, T. L. (1981). Financial and intangible factors in fleet lease or buy decision. *Industrial Marketing Management, 10*, 1-10.

Wakefield, K. L., & Barnes, J. H. (1996). Retailing hedonic consumption: A model of sales promotion of a leisure service. *Journal of Retailing*, *72*(4), 409-427.

Whyte, L. L. (1969). Structural hierarchies: A challenging class of physical and biological problems. In L.L. Whyte, A.G. Wilson & D. Wilson (Eds.), *Hierarchical Structures* (pp. 3-17). New York: Elsevier.

Wright, P., & Barbour, F. (1977). Phased decision strategies: Sequels to initial screening. In M. Starr, & M. Zeleny (Eds.), *Multiple Criteria Decision Making* (pp. 91-109). Amsterdam: North Holland TIMS Studies in Management Science.

Zahedi, F. (1986). The analytic hierarchy process–a survey of the method and its applications. *Interfaces, 16*(4), 96-108.

APPENDIX A

Questionnaire for Self-Explication Method

Stage 1: Reduce choices to five shoes

a. Select five walking shoes from the selection pool without trying on and write down the shoe numbers of the five selected shoes.

   _____ _____ _____ _____ _____

b. Which attribute is the most important in selecting the five walking shoes? (select one)

   1. comfort 2. fit 3. technical feature 4. fashion 5. brand 6. price

Stage 2: Make a final choice

a. Try on the five selected shoes one by one and walk a little.

b. Which shoes are your top three choices among the five selected shoes? (please, write down shoe numbers)

   1._____

   2._____

   3._____

c. Which shoe is your final choice? (please, write down shoe number)

   _____

d. How important are the six attributes in making the final choice? (pleas rate the importance on the following scale: 1 (unimportant), 2 (of little importance), 3 (moderately important), 4 (important), 5 (very important))

   i. Comfort _____

ii. Fit _____

iii. Technical features _____

iv. Style/fashion _____

v. Brand _____

vi. Price _____

APPENDIX B

Questionnaire for AHP Method: Pairwise Data Collection

Stage 1

The five shoes selected in the first stage of the self-explication method are used for AHP method.

Stage 2: Make a choice by pairwise comparisons – in the intensity scale, hided even numbers (2, 4, 6 and 8) represent intermediate intensities of two adjacent odd numbers.

a. Pairwise comparisons of the criteria – quality, fashion/style, and others (brand & price)

Which criterion is more important in each pairwise comparison in terms of selecting proper athletic shoes for walking and by how much? (make check marks at the numbers representing the intensity of importance)

In terms of selecting walking shoes (intensity: importance)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
quality	9	7	5	3	1	3	5	7	9	fashion
quality	9	7	5	3	1	3	5	7	9	others
fashion	9	7	5	3	1	3	5	7	9	others

b. Three pairwise comparisons of attributes

i. Which one is more important between comfort and fit in terms of quality and by how much? (make a check mark at the numbers representing the intensity of importance)

In terms of quality (intensity: importance)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
comfort	9	7	5	3	1	3	5	7	9	fit

ii. Which one is more important between technical feature and fashion in terms of fashion/style and by how much? (make a check mark at the intensity of importance)

In terms of fashion/style (intensity: importance)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
tech	9	7	5	3	1	3	5	7	9	fashion

iii. Which one is more important between brand and price in terms of others and by how much? (make a check mark at the numbers representing the intensity of importance)

In terms of others – brand and price (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
brand	9	7	5	3	1	3	5	7	9	price

c. Pairwise comparisons of walking shoes

i. Which shoes do you prefer in terms of comfort and by how much? (make check marks at the numbers representing the intensity of preference)

In terms of comfort (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe2
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe3
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 3
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 4	9	7	5	3	1	3	5	7	9	Shoe 5

ii. Which shoes do you prefer in terms of fit and by how much? (make check marks at the numbers representing the intensity of preference)

In terms of fit (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe2
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe3
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 3
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 4	9	7	5	3	1	3	5	7	9	Shoe 5

iii. Which shoes do you prefer in terms of technical features and by how much? (make check marks at the numbers representing the intensity of preference)

In terms of technical features (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe2
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe3
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 3
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 4	9	7	5	3	1	3	5	7	9	Shoe 5

iv. Which shoes do you prefer in terms of fashion and by how much? (make check marks at the numbers representing the intensity of preference)

In terms of fashion (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe2
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe3
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 3
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 4	9	7	5	3	1	3	5	7	9	Shoe 5

v. Which shoes do you prefer in terms of brand and by how much? (make check marks at the numbers representing the intensity of preference)

In terms of brand (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe2
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe3
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 3
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 4	9	7	5	3	1	3	5	7	9	Shoe 5

vi. Which shoes do you prefer in terms of price and by how much? (make check marks at the numbers representing the intensity of preference)

In terms of price (intensity: preference)

	Extreme	very strong	strong	slight	equal	slight	strong	very strong	extreme	
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe2
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe3
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 1	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 3
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 2	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 4
Shoe 3	9	7	5	3	1	3	5	7	9	Shoe 5
Shoe 4	9	7	5	3	1	3	5	7	9	Shoe 5

APPENDIX C

Questionnaire for AHP Method: Evaluation

1. Are you going to accept the top scored shoe from the above chart you filled out as your final choice?

   ☐ Yes

   ☐ No

2. How satisfied are you with your final choice? (please circle appropriate answer)

   1 (unsatisfied)

   2 (a little satisfied)

   3 (moderately satisfied)

   4 (satisfied)

   5 (very satisfied)

3. How satisfied are you with overall AHP procedures? (please circle appropriate answer)

   1 (unsatisfied)

   2 (a little satisfied)

   3 (moderately satisfied)

   4 (satisfied)

   5 (very satisfied)